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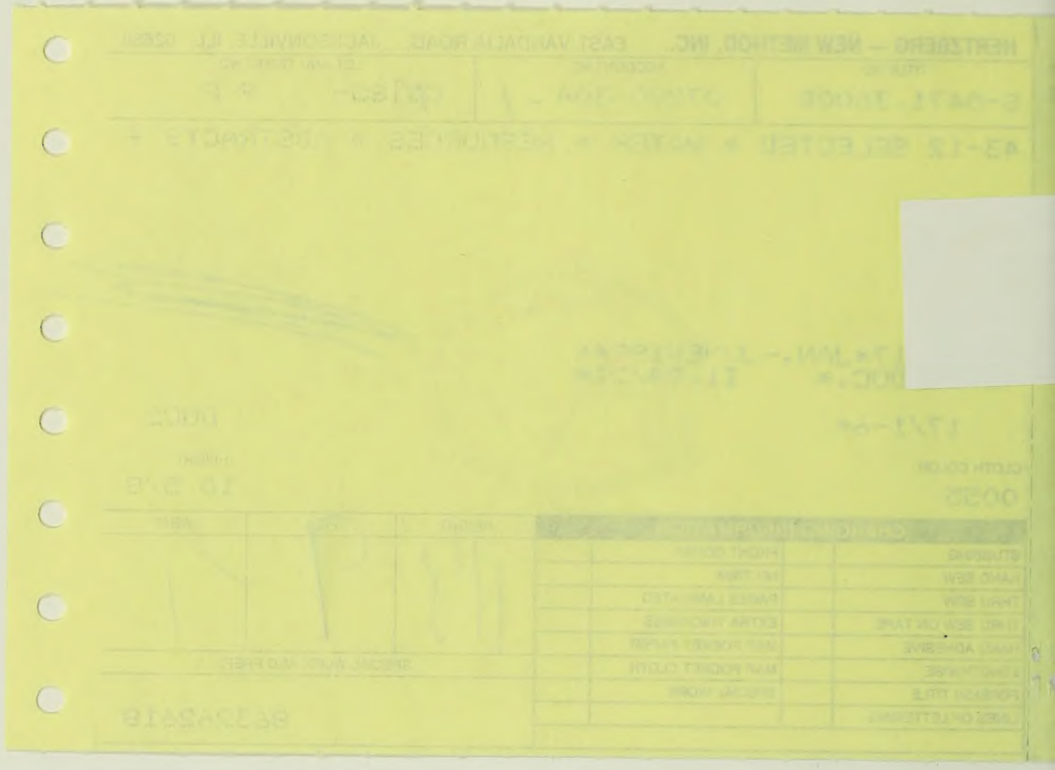

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 17, NUMBER 1
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 1
JANUARY 1984

W84-00001 -- W84-00350

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

A METHOD FOR CALCULATING THE RATE OF BIOSEDIMENTATION THROUGH THE LOWER BOUNDARY OF THE PHOTOSYNTHETIC ZONE IN SEA WATER,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
V. N. Yegorov, V. N. Ivanov, and L. V. Migal.
Hydrobiological Journal, Vol 17, No 4, p 69-74, 1981. 3 Fig, 15 Ref.

Descriptors: *Sea water, *Biosedimentation, Sedimentation, Photosynthesis, Vertical flow, Vertical distribution, Water chemistry, Uranium-238, Thorium-234, *Indian Ocean.

An attempt was made to calculate the rate of water exchange in the euphotic layer on the basis of data about its productivity and on the vertical distribution of various forms of zinc. Use was made of the balance equations for zinc and Th-234 to analyze both the rate of biosedimentation and the velocity of water exchange in the euphotic layer. Studies were based on data from a test area in the Indian Ocean. The rate of water exchange through the lower boundary of the photosynthetic zone and the biosedimentation potential of the euphotic layer could be calculated on the basis of simultaneous observations of the vertical distribution of a trace element (zinc) and the shift in the equilibrium concentrations of uranium 238 and thorium 234. The errors of the method are discussed. (Baker-FRC)
W84-00143

2. WATER CYCLE

2A. General

MODELING SURFACE AND SUBSURFACE STORMFLOW ON STEEPLY-SLOPING FORESTED WATERSHEDS,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 4D.
W84-00032

IMPROVED METHODS AND GUIDELINES FOR MODELING STORMWATER RUNOFF FROM SURFACE COAL MINED LANDS,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 4C.
W84-00033

HYDROLOGY OF A SMALL IMPOUNDMENT AND WATERSHED IN CENTRAL OKLAHOMA,
Agricultural Research Service, Chickasha, OK.
R. Schoof.
Water Resources Bulletin, Vol 19, No 1, p 15-21, February, 1983. 4 Fig, 6 Tab, 9 Ref.

Descriptors: *Watershed, *Impoundments, *Hydrology, *Oklahoma, Runoff, Rainfall-runoff relationships, Evapotranspiration, Evaporation, Bitter Creek.

An analysis is presented of a site impoundment's water budget for five years of record, along with a study of the temporal and spatial distribution of water yield from the contributing watershed, measured from 1972 through 1980. On-site loss of water from the impoundment was only 17% of the inflow during three years when the annual precipitation averaged 26 inches and the annual inflow averaged 1.4 inches. Runoff from an eroded area with no farm ponds was about 70% greater per unit area than from a portion of watershed where 71% of the drainage area was controlled by farm ponds. Loss of top soil increased runoff significantly. Only 24% of the total runoff into the impoundment was base flow. The flow rate into the impoundment was less than 0.05 cfs 70% of the time, and the inflow rate exceeded 10 cfs only 1% of the time. SCS runoff curve numbers varied between 57 and 96 for the impoundment watershed, with an inverse relation between precipitation amount and curve number, apparently caused by partial area runoff from impervious and semi-impervious areas. A comparison of measured event runoff computed by the SCS curve numbers gave an r sq of only 0.44. However, the total computed surface runoff for eight years of record was less than 1% below the measured runoff, which indicated that the curve number method was a good tool for predicting long term runoff for the watershed. (Baker-FRC)
W84-00098

CONSTANT VELOCITY KINEMATIC ANALYSIS OF AN INFILTRATING MICROCATCHMENT HYDROGRAPH,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
Y. Zarmi, J. Ben Asher, and T. Greengard.
Water Resources Research, Vol 19, No 1, p 277-283, February, 1983. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Infiltration, *Surface flow, *Water harvesting, Arid lands, Hydrodynamics, Rainfall intensity, Hydrographs, Flow patterns, Overland flow, Flow velocity, Soil properties, Runoff.

This paper describes the development and testing of a physical model to predict the hydrodynamic processes on a natural microcatchment of about 200 sq m, which is the size needed in arid zones for providing irrigation water for one tree. Rainfall was applied to a 125 sq m catchment with a fairly uniform grade of 1%. The recession parts of the hydrographs were similar for rainfall intensities of 60, 40, 20, and 10 mm per hour. Recession lasted about 10 min and was independent of the surface detention. Recession limbs of the hydrographs decreased very rapidly the moment the rain stopped and appeared as a series of parallel, nearly perpendicular lines on the discharge vs. time plot. It was possible to assume that the velocity of water flow on the surface was constant, independent of time or position along the catchment. This allowed the analytical solution of the continuity equation to be simplified, providing better insight into the problem of surface flow. (Cassar-FRC)
W84-00111

RUNOFF MODEL FOR WATERSHEDS OF NONHOMOGENEOUS HYDROLOGIC CHARACTERISTICS,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113596, Price codes: A07 in paper copy, A01 in microfiche.
New Mexico Water Resources Research Institute Technical Report No. 176, Las Cruces, September 1983. 136 p, 11 Fig, 6 Tab, 54 Ref, 5 Append.
OWRT A-068-NMEX(1), 14-34-0001-2133.

Descriptors: *Small watersheds, *Hydrologic models, Runoff, Watershed studies, *Flood routing, Water yield, Infiltration, *Watershed models, Model studies, New Mexico, Four Hills watershed, North Camino watershed.

A Watershed of any configuration, topography, spatial distribution of cover and soil, and channel characteristics is described as non-homogeneous finite-element surface grid. Time-varying precipitation is applied to the watershed and runoff is hydraulically routed over the surface in discrete time increments. Infiltration is abstracted by a variable rate model derived from SCS curve numbers. Precipitation infiltrates, stands, and/or runs off each quadrant in accordance with that quadrant's slope and hydrologic characteristics. Overland flow is routed to channels, and channel flow is then routed to the basin's point of discharge. The grid definition of the watershed surface makes the model appropriate for watershed not adequately modeled by conventional, nondistributed hydrologic means. The model does not require that unit hydrographs or times-of-concentration be estimated.
W84-00137

HYDROGEOLOGY (HYDROGEOLOGIE),
Centre National de la Recherche Scientifique, Moulis (France). Lab. Souterrain.
A. Mangin.
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Serie 2: Mecanique-Physique, Vol 293, No 14, p 1011-1014, 1981. 3 Fig, 8 Ref.

Descriptors: *Hydrographs, *Hydrograph analysis, Discharge hydrographs, Rainfall, Simulation analysis, Mathematical studies.

The application of cross correlation and cross spectral analysis to rainfall and discharge time series leads to a better hydrological system identification through improved results from unit hydrographs, their analysis with respect to the functioning of the hydrological systems, and quantitative estimation of source parameters, such as linearity. These factors constitute a valuable step for the investigation of system simulation. (Author's abstract)
W84-00310

TRENDS IN THE VARIATION OF SURFACE WATERS OF THE HYDROSPHERE,
R. K. Klige.
Water Resources (English Translation), Vol 9, No 3, p 272-284, May-June, 1982. 5 Fig, 4 Tab, 40 Ref. Translated from Vodnye Resursy, No 3, p 92-105, May-June, 1982.

Descriptors: *Surface water, *Temperature effects, *Water exchange, *Water resources, World ocean, Evaporation, Global water, Hydrosphere, Geohydrology, Groundwater hydrology, Water levels.

In order to correctly understand current changes and trends in surface waters of the hydrosphere a determination was made of the processes of evolution of natural waters that led to their present state. In this connection the paleohydrologic conditions for individual successive time segments were reconstructed. Specific time periods included the earth's early stages of geologic history, Early Makhachkala, Shikhova, Late Makhachkala, Begdash, Sartas, Julala, Dagestan, Zhelanda, Gousan, Izberbash, Turala, Aleksandrbai, Uluchaevo, Abeskun, the late history and the present time. The very early stages of earth's geologic history were also included along with the Phanerozoic period and the late Paleozoic period. An investigation of global water-exchange processes shows that under the existing climatic conditions and in the future a directed change in the components of the water balance of the earth's surface will occur as a result of which land water supplies will be reduced by about 133 cubic km/yr and the volume of glaciers by 183 cubic km/yr with further replenishment of the World Ocean at a rate of 316 cubic km/yr. Modeling of changes in the conditions of global water exchange are considered for temperature changes of 1 and 2.5 degrees. (Baker-FRC)
W84-00316

WATER BALANCE OF THE BLACK SEA IN THE LATE VALDAI GLACIAL EPOCH,
Moscow State Univ. (USSR).
S. I. Varushchenko.
Water Resources (English translation), Vol 9, No 3, p 311-313, May-June, 1982. 2 Tab, 11 Ref. Translated from Vodnye Resursy, No 3, p 136-138, May-June, 1982.

Descriptors: *Water resources, *Water balance, *Geohydrology, Hydrosphere, Water exchange, Glaciers, Europe, USSR, Don River, Danube River, Dnestr River, Dnepr River, Black Sea.

On the basis of the bathygraphic curve, the areas and volumes of water are calculated for the Black Sea for two levels: the early maximum level of the Bosporus sill (-35 m) and the surface corresponding to the present day 95-m depth of the sea. The first level, having an area of about 402,000 sq km,

dates to the epochs of detachment and subsequent joining of the water body to the Mediterranean Sea, and the second, having an area of about 367,000 sq km, corresponds to the average level of development of the deepest New Euxine lake terraces of those expressed in the bottom relief. The data presented permit an approximate determination of how much the mean annual runoff to the New Euxine Lake decreased in the time interval from 29,000 to 9000 years ago compared to the present runoff to the Black Sea. Since from 85 to 90% of the surface waters in the New Euxine Lake came from rivers emptying into it from the north, it is concluded that the main cause of the drop of the level of this water body after its detachment from the ocean was the abrupt and very substantial reduction of the volume of river runoff from the periglacial region of the glacier during its occurrence and stabilization in the maximum phase of development. In the initial and final stages of development of the glacier the runoff was about two times and at the maximum possibly even twelve times less than the present day. The data indicate that during the last glaciation the basins of the Danube, Dnestr, Dnepr, and Don were in a zone of quite feeble moistening. The calculations indicate an exceptionally dry climate in the area and indirectly confirm the possibility of the wide develelopment of tundra steppes in the indicated period in southern Europe. (Baker-FRC)
W84-00332

THE HYDROLOGICAL SUSA-STUDY,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
E. Hansen, and M. Dyhr-Nielsen.
Nordic Hydrology, Vol 13, No 5, p 257-262, 1982. 2 Fig.

Descriptors: *Rainfall-runoff relationships, *Model studies, Hydrologic models, Denmark, Hydrology.

A short description is offered of a 4.5 year hydrological research project constituting a Danish contributon to UNESCO's International Hydrological Program. The main objectives of the project were to study the hydrologic processes in a catchment with a regional confined aquifer covered by boulder clay; the consequences of increased ground water development on groundwater hydraulic heads and streamflow; the possibilities of establishing an integrated water resources development, taking into account joint effects of water abstraction and sewage disposal on the water quantity and quality of the streams in the catchment. Field studies of hydrological processes were conducted for precipitation, evapotranspiration, subsurface runoff, groundwater recharge, hydrogeology, interaction between groundwater and surface water, runoff and lake storage, and chemistry of ground- and surface water. Mathematical modeling of hydrological processes and systems were constructed for evapotranspiration, groundwater, rainfall-runoff, and integrated hydrologic models. (Baker-FRC)
W84-00338

ESTIMATION OF THE VOLUME OF REGENERATED WATER OF THE CONTINENTAL CRUST IN GLOBAL WATER EXCHANGE,
O. M. Rozen.
Water Resources (English Translation), Vol 9, No 3, p 285-297, May-June, 1982. 4 Fig, 6 Tab, 50 Ref. Translated from Vodnye Resursy, No 3, p 106-118, May-June, 1982.

Descriptors: *Water exchange, *Water resources, *Hydrosphere, *Geohydrology, World Ocean, Paleohydrology.

An attempt has been made to estimate the balance of buried water and water released from volcanogenic-sedimentary rocks during the formation of the earth's crust. The examination of the indicated balance was limited to only two principal forms of burial of water: first, water present in the crystal lattice of minerals of sedimentary rocks and amenable to a theoretical quantitative estimation, and second, water filling the pores of sedimentary rocks and which is to a considerable extent relict and syngenetic, a quantitative estimation of which can be made on the basis of the data on the total porosity of sedimentary rocks. The data obtained show that during the formation of both the lower and upper horizons of the continental crust vast amounts of water were buried, which are quite close to those calculated for interstitial waters of nonmetamorphosed deposits and equal to about 20% of the entire hydrosphere. They exceed by an order of 1.5 the mass of ice, rivers, lakes, and water in the atmosphere taken together. The amount of water buried in rocks during the entire history of the earth amounts to 60% of the entire hydrosphere. The release of such masses of water led to a change in the volume of the World Ocean. For estimating such a flow of water it is assumed that it occurred in each of the principal epochs of metamorphism and granitization in the Precambrian period. Bulging up of granitoids and orogeny, leading to the geologically instantaneous supply of a large amount of terrigenous material to the ocean, are an important accompanying consequence of global epochs of metamorphism. The combination of an increase in the volume of water and its displacement by the incoming terrigenous sediments should have led to an increase of its level and to transgressions. The periodic rises of the World Ocean level were probably originally quite intense, gradually decreasing in intensity with the passage of time. (Baker-FRC)
W84-00345

INTERRELATIONSHIP BETWEEN RELIEF, GLOBAL CLIMATE, AND WATER EXCHANGE,
L. V. Zorin.
Water Resources (English Translation), Vol 9, No 3, p 329-334, May-June, 1982. 44 Ref. Translated from Vodnye Resursy, No 3, p 156-161, May-June, 1982.

Descriptors: *Water exchange, *Geohydrology, *Water resources, World Ocean, Temperature effects, Climate, Water balance, Hydrosphere, Advection, Convection.

The effect of the relief on global climate and water exchange is investigated. Along with the paleogeographic aspect the present day aspect of the relation between continental relief and water balance is considered. It is noted that the amount of solar energy received by the earth periodically changed to extents which caused fluctuations of the climate and water exchange and the occurrence of glaciation and pergelation. Variations of the climate and water exchange, having a periodic large-scale character, were related mainly to the geotectonic evolution of the earth. There are direct indications that glaciation on the earth actively degrades; having reached a maximum in the Middle Pleistocene, it expanded in surges but on a considerably smaller scale in the Upper Pleistocene and in the Little Ice Age. Presently global glaciation is decreasing, which is displayed in unstable melting of present-day glaciers of both the mountain and, in part, flatland types and also of permafrost. It is concluded that the more complex the relief, the more complex the processes of advection and the more active the processes of convection. More complex reliefs also call for greater complexity in the circulation processes and for a more complicated process of large-scale condensation occurring on land. In epochs of plantation and denudation of mountains, that is, in epochs of cessation or slowing of global expansion, equalization of the climate will occur, accompanied by melting not only of mountain glaciers but also of the polar ice caps. The climate will become ordered, and water exchange will stabilize, with natural waters concentrating in the oceans. (Baker-FRC)
W84-00346

2B. Precipitation

CHEMICAL COMPOSITION AND SPATIAL VARIATION OF BULK PRECIPITATION AT A COASTAL PLAIN WATERSHED IN SOUTH CAROLINA,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
D. D. Richter, C. W. Ralston, and W. R. Harms.
Water Resources Research, Vol 19, No 1, p 134-140, February, 1983. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Precipitation, *Spatial variation, *Chemical composition, Water pollution sources, Fate of pollutants, *South Carolina, Phosphates, Sulfates, Nitrates, Ammonium, Hydrogen ion concentration, Rain, Chlorides, Potassium, Sodium, Magnesium, Calcium, Forest watersheds, Nutrients.

Ionic constituents of rain water were determined in samples from 8 stations in a 500-ha watershed in the Francis Marion National Forest, located in the coastal plain of South Carolina. Mean annual deposition rates of ions (kg per ha) were: H+, 0.64; Ca(++), 5.69; Na+, 5.66; Mg(++), 1.68; ammonium-N, 0.83; K+, 0.94; sulfate-S, 7.51; chloride, 14.2; nitrate-N, 1.76; and phosphate-P, 0.12. Spatial variations were < 10% for sulfate-S, nitrate-N, and Ca(++); intermediate for Mg(++), chloride, H+, and Na+; and 30-35% for ammonium-N, phosphate-P, and K+. Sources of the various constituents were oceanic salts, fossil fuel combustion, natural biogenic processes, agricultural activities, and soil-derived particulates. For this watershed 19 sample collectors would be sufficient to estimate annual bulk precipitation inputs within 10% of true mean for sulfate, nitrate, Ca(++), Mg(++), chloride, H+, and Na+, whereas 35 collectors would be required to provide similar confidence intervals for ammonium, phosphate, and K+. (Cassar-FRC)
W84-00108

A POINT PROCESS MODEL OF SUMMER SEASON RAINFALL OCCURRENCES,
Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith, and A. F. Karr.
Water Resources Research, Vol 19, No 1, p 95-103, February, 1983. 24 Ref.

Descriptors: *Rainfall, *Drought, *Cluster analysis, Model studies, Seasonal variation, Precipitation, Potomac River Basin, Meteorology, Stochastic hydrology, *Model studies, *RCM processes.

A point process model of summer season rainfall occurrences is developed. The model, which is termed an RCM process (renewal Cox process with Markovian intensity), is a member of the family of Cox processes (Poisson processes for which the rate of occurrence of events varies randomly over time). Model development is based on counts and interarrival time statistics estimated from Potomac River basin rainfall data. The counting parameters used are the conditional intensity function, index of dispersion and counts spectrum; the interarrival time parameters are the coefficient of variation and the autocorrelation function. Explicit results are presented for the counts and interarrival time parameters of RCM processes. For the RCM process the rate of occurrence alternates between two states, one of which is 0, the other positive. The form of the intensity process suggests that clustering of summer season rainfall occurrences in the Potomac River basin results form the alternation of wet and dry periods. Computational results are presented for two extensions of the RCM process model of rainfall occurrences: a marked RCM process model of rainfall occurrences and associated storm depths and a bivariate RCM process model of rainfall occurrences at two sites. (Author's abstract)
W84-00117

A SIMPLE PROCEDURE FOR CALCULATING ATMOSPHERIC WATER VAPOR CONCENTRATION,
California Inst. of Tech., Pasadena.
G. J. McRae.
Journal of the Air Pollution Control Association, Vol 30, No 4, p 394, April, 1980. 2 Ref.

Descriptors: *Water vapor, *Mathematical equations, *Relative humidity, Mathematical studies, Air temperature, Atmospheric pressure.

A simple procedure, accurate to 0.5% over a range of plus or minus 50 degrees, is presented for calculating water vapor concentration without the use

of psychrometric charts or tables. The mathematical equation which equates relative humidity to the ratio of the mole fraction of water vapor in the moist atmosphere to the mole fraction at saturation is rewritten using Dalton's gas laws and Richards' polynomial expression. The resultant expression allows the determination of water vapor concentration in parts per million units or in other unit systems by straightforward conversion. (Geiger-FRC)
W84-00304

METHODS FOR CALCULATING AREAL PRECIPITATION - APPLIED TO THE SUSA-CATCHMENT,
Danish Meteorological Inst., Copenhagen.
P. Allerup, H. Madsen, and J. Riis.
Nordic Hydrology, Vol 13, No 5, p 263-278, 1982. 18 Fig, 1 Tab, 13 Ref.

Descriptors: *Rainfall distribution, *Terrain analysis, *Wind, Susa catchment, Catchment areas, Hills, Rainfall, Distribution, Topography.

In order to study the influence of the terrain on the precipitation pattern in the Susa catchment, a separate raingauge setup was established in two hilly areas. Before calculation of real precipitation could be carried out, correction of precipitation due to systematic errors was needed. A special method, the TTSE method, was developed to take into account the terrain characteristics. The Susa catchment is characterized by a gently undulating landscape surrounding the Susa and its tributaries. Ranges of hills rise 20-30 m above the surrounding landscape in some areas and 80-90 m in others. A statistical model study was carried out to analyze the data collected from the raingauge network. It appeared from the study that both the existence of small hills and the direction of the wind influence the amount of precipitation a given area will receive. (Baker-FRC)
W84-00342

2C. Snow, Ice, and Frost

ICE BREAKUP AND JAMMING OBSERVATIONS ALONG THE MACKENZIE RIVER,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
J. W. Kamphuis, and J. R. Moir.
Canadian Journal of Civil Engineering, Vol 10, No 1, p 78-91, 1983. 14 Fig, 1 Tab, 2 Ref.

Descriptors: *Ice breakup, *Ice jams, *River flow, Floating ice, Mackenzie River, Melting.

Ice breakup in the northerly flowing Mackenzie River, Canada, between Forts Simpson and Good Hope was studied in 1979-1981. This paper reports the observations made from 40 aircraft flights in 1980-81. Shortly before initial downstream movement of the ice open water is seen around islands, along main shores, over shoals, and in shallow secondary channels, with remnants of shorefast ice in the apparently open water areas. In deep straight reaches the river is almost entirely covered with a solid floating ice sheet. Ice begins to move downstream when the forces keeping the ice in place are exceeded by the driving forces (gravity, shear stress on the bottom of the ice, and form drag by the flow on the ice sheet). Ice movement begins in the shallow, braided sections, forming a mush of relatively small pieces with some larger flows. Moving downstream, the mush encounters more solid ice in the straight stretches, pushing on it until the sheet moves as a unit for up to 1 km. Thickening occurs in the downstream section of the mush and along the shores. Several jams, separated by open water, appear in a river simultaneously. Release of the jam may occur by movement of the whole ice mass or by downstream movement of the mush through failures in the solid ice sheet or under the ice sheet. Breakup, rate of breakup, and jam clearing are dependent on the strength of the ice, air temperature, and wind velocity. (Cassar-FRC)
W84-00071

2D. Evaporation and Transpiration

EVAPORATIVE LOSSES FROM COOLING PONDS,
Clemson Univ., SC. Dept. of Civil Engineering.
B. L. Sill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111863, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 110, Clemson Univ., S.C., September 1983. 47 p, 10 Fig, 4 Tab, 34 Ref. OWRT A-052-SC(1), 14-34-0001-1143-2143,0143.

Descriptors: *Evaporation, *Evaporation Rate, *Cooling ponds, *Waste heat, *Convection, Water loss, Water consumption, Lakes, Thermal pollution.

Cooling ponds have been routinely utilized for the dissipation of industrial waste heat. A by-product of this application is an increase in evaporative losses over the naturally occurring value. The present study describes some analyses of this evaporation and means to measure and/or calculate it. Mathematical models using an energy budget approach are shown to be least sensitive to errors in the wind speed function. The second portion of the study examines the relative effects of evaporation resulting from free convection (zero windspeed) and forced convection. A new evaporation equation for heated and nonheated lakes is presented.
W84-00046

2E. Streamflow and Runoff

RECOVERY PATTERNS IN STREAM COMMUNITIES IMPACTED BY THE MT. ST. HELENS ERUPTION,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W84-00039

IMPACT OF DROUGHT ON QUALITY OF POTENTIAL WATER SUPPLY SOURCES IN THE SANGAMON RIVER BASIN,
Southern Illinois Univ. at Carbondale. Dept. of Thermal and Environmental Engineering.
C. B. Muchmore, and B. Dziegielewski.
Water Resources Bulletin, Vol 19, No 1, p 37-46, February, 1983. 6 Fig, 5 Tab, 10 Ref.

Descriptors: *Water quality, *Drought, *Water supply, Water resources development, Ammonia, Manganese, Phenols, Specific conductance, Rivers, River basins, Streamflow, *Illinois, Sangamon River basin.

An analysis was made of streamflow and several water quality parameters in six Illinois rivers. The analysis showed that the 1976-77 drought produced significant streamflow deficiencies in the investigated streams of the 5,000 sq mile basin of the Sangamon River. Temporal and spatial variability of precipitation deficits within the basin had insignificant effects on the differentiation in timing of extremely low flows among various streams. The impact of drought on water quality was less uniform than the impact on streamflow. Overall, streamflow quality deteriorated, as a result of abnormally high concentrations of ammonia, maganese, and to a lesser extent, phenol and specific conductance. Significant decreases in concentrations of nitrites and nitrates, coliform bacteria, and total iron were noted. The approach to the analysis of water quality, using 12-month moving averages of monthly quality measurements, proved to be sensitive enough to clearly isolate the impact of drought from seasonal fluctuations in water quality. The analysis of instream flow and moving averages of nitrogen species concentrations revealed two distinct patterns of response to drought. They corresponded to streams chararcterized by an alternately high or low contribution of treated municipal effluent to low flow. The effects of land use patterns on water quality during the drought were hard to isolate due to the relative similarity of land uses for all investigated subbasins. However, the more general thesis regarding the significant differences in response to drought among various streams seems to be substantiated in the case of impacts on water quality. It is suggested that streams which are considered unsuitable for municipal supply due to high levels of the quality indicators studied may be used as emergency sources during droughts. (Baker-FRC)
W84-00105

EXTREMAL HYPOTHESES FOR RIVER BEHAVIOR,
Canterbury Univ., Christchurch (New Zealand). Dept. of Agricultural Engineering.
T. R. H. Davies, and A. J. Sutherland.
Water Resources Research, Vol 19, No 1, p 141-148, February, 1983. 2 Fig, 1 Tab, 38 Ref.

Descriptors: *Energy dissipation, *River flow, *Friction, Streamflow, Turbulent flow, Laminar flow, Alluvial rivers, Minimization hypotheses, Sediment transport.

The hypotheses of minimum energy dissipation, minimum stream power, and minimum unit stream power are summarized and compared. Their derivation from analogies with laminar flow and linear thermodynamics is criticized on the grounds that these situations differ fundamentally from river flows, which are usually highly turbulent and strongly nonlinear. The authors' empirical hypothesis of maximum friction factor seems preferable to the minimization hypotheses because it is compatible with the known behavior of turbulent flows and nonlinear processes, it is applicable with a wider range of independent variables, and it is more in keeping with trends shown by experimental data under all constraints. The minimization hypotheses seem likely to give incorrect predictions when flow rate and depth are independent variables. The empirical success of the minimization hypotheses is confined to situations in which they predict similar behavior to the maximum friction factor hypothesis; they may be considered as special cases of this more general hypothesis. (Author's abstract)
W84-00129

A TIME DEPENDENT, TWO-LAYER FRONTAL MODEL OF BUOYANT PLUME DYNAMICS,
Delaware Univ., Newark. Coll. of Marine Studies.
J. O'Donnell, and R. W. Garvine.
Tellus, Vol 35A, No 1, p 73-80, 1983. 7 Fig, 19 Ref.

Descriptors: *Mathematical equations, *Plumes, *Buoyancy, Mississippi River, Connecticut River, Rivers, Dynamics.

The one-dimensional, time dependent behavior of a two-layer frontal model is considered in a study of the dynamics of buoyant plumes such as those observed at the mouths of the Mississippi and Connecticut Rivers. The long wave equations are solved numerically with several different boundary conditions in order to illustrate some of the properties of the model. The results of the four numerical experiments performed demonstrated that the frontal motion of buoyant plumes is strongly controlled by the flow at the inlet. Control is exerted by the generation of internal waves which propagate toward the front, where they modify the flow. If changes in the inlet flow occur with short time scales, then these internal waves can develop into surges or bores which would effectively increase the amount of interfacial mixing. These results, together with those of Garvine, encourage the extension of this model and its numerical solution technique to two horizontal dimensions in order to more closely approximate the behavior of natural buoyant plumes. (Baker-FRC)
W84-00178

COMMENT ON 'OPTIMAL RISK-BASED DESIGN OF FLOOD LEVEE SYSTEMS' BY Y.-K. TUNG AND L. W. MAYS,
Tiszadata Consulting Engineers, Budapest (Hungary).
I. Bogardi, and L. Duckstein.

Water Resources Research, Vol 18, No 6, p 1745-1746, December, 1982. 6 Ref.

Descriptors: *Levees, *Flood routing, Flood protection, Optimization, Design criteria, Dynamic programming.

A comment on the above titled paper, published in Water Resources Research, Volume 17, No 4, pages 843-852, 1981, states that the assumption that no routing techniques are applied to route the flood hydrography through the levee system does not take into account the observation that flooding in an upstream reach decreases the peak stage in the downstream reaches. Closed loop methods are proposed as alternatives to this open loop method. (Cassar-FRC)
W84-00350

2F. Groundwater

A CASE STUDY OF DRY WELL RECHARGE,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 5E.
W84-00013

AN EIGENVALUE NUMERICAL TECHNIQUE FOR SOLVING UNSTEADY LINEAR GROUNDWATER MODELS CONTINUOUSLY IN TIME,
Servicio Geologico de Obras Publicas, Madrid (Spain).
A. Sahuquillo.
Water Resources Research, Vol 19, No 1, p 87-93, February, 1983. 14 Ref.

Descriptors: *Groundwater management, *Groundwater movement, *Aquifers, Differential equations, Eigenvalues, Numerical analysis, Piezometric head, Leaky aquifers, Confined aquifers, Pumping.

A procedure is presented for solving the differential groundwater flow equation. Using a finite difference or finite element discretization scheme, a set of simultaneous linear equations is obtained. The eigenvalues and eigenvectors of a matrix, which is a function of the coefficients of the set, are the key to the solution. A vector (L) is obtained straightforwardly by combining the eigenvector matrix (A), the eigenvalue vector, the pumping vector (P), and the initial head vector. Vector L, which depends on time, can be expressed simply and explicitly as a function of the eigenvalues. Piezometric heads can be obtained by combining A and L. L is the only vector that needs to be computed as P changes with time. In this way, influence functions of a piezometric head, flow velocity, and flow depletion of a stream connected with the aquifer under a unit stress can be obtained explicitly and continuously in time. The method can be applied to confined as well as to leaky aquifers and to one-, two-, or three-dimensional linear models. Its main advantage lies in the fact that it is unnecessary to repeatedly solve a matrix for every time increment. The method is particularly useful for groundwater management problems in which a large number of alternatives have to be evaluated. (Author's abstract)
W84-00083

AQUIFER PARAMETER IDENTIFICATION WITH KRIGING AND OPTIMUM PARAMETERIZATION,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. W. G. Yeh, Y. S. Yoon, and K. S. Lee.
Water Resources Research, Vol 19, No 1, p 225-233, February, 1983. 9 Fig, 4 Tab, 17 Ref.

Descriptors: *Aquifer properties, *Parametric hydrology, Groundwater movement, *Kriging.

A new parameter identification method is developed for a two-dimensional, unsteady state groundwater flow model. The method is a direct approach, as it requires no iterative searching of parameters. The unknown functional coefficients (parameters) are optimally determined by a generalized matrix inversion scheme. Kriging, an unbiased minimum variance estimator, is used as a presampling filter to reconstruct the head distribution for the entire flow domain. The ill-posedness of the inverse problem as characterized by instability and nonuniqueness is controlled by reparameterization utilizing the technique of finite elements. A set of statistics was developed to quantify explicity the tradeoff between the system modeling error and the error associated with the parameter uncertainty. These two types of errors were shown to be a function of the parameter dimension. Residual mean square and trace of the covariance matrix of the estimated parameters served as good indicators for the determination of the optimum parameter dimension. A set of numerical experiments was conducted to illustrate the methodology. (Author's abstract)
W84-00085

HEAT TRANSFER IN FRACTURED GEOTHERMAL RESERVOIRS WITH BOILING,
California Univ., Berkeley. Lawrence Berkeley Lab.
K. Preuss.
Water Resources Research, Vol 19, No 1, p 201-208, February, 1983. 10 Fig, 1 Tab, 20 Ref.

Descriptors: *Heat transfer, *Geothermal studies, *Porous media, Geologic fractures, Enthalpy, Permeability, Injection wells.

Nonisothermal flow of water and steam in idealized fractured porous media was studied with analytical and numerical techniques. Several conclusions were reached. The behavior of fractured boiling reservoirs can be different from porous medium-type reservoirs with the same permeability and porosity, even in cases where fracture spacing is small. Heat transfer to fractures by conduction is very important if matrix permeability is low. For production without reinjection reservoir response depends more strongly upon matrix permeability than on fracture spacing. It is possible that fractured geothermal reservoirs may produce superheated steam even in the presence of large quantities of liquid water flowing in the matrix. Full reinjection can be effective for maintaining pressure in fractured reservoirs. Excellent thermal sweeps can be achieved even in cases with large fracture spacing (several hundred meters) unless major short circuits in fractures are present. (Cassar-FRC)
W84-00086

A NUMERICAL PROCEDURE FOR THE SOLUTION OF THE STEADY STATE VARIABLE DENSITY GROUNDWATER FLOW EQUATION,
Geological Survey, Austin, TX. Water Resources Div.
L. K. Kuiper.
Water Resources Research, Vol 19, No 1, p 234-240, February, 1983. 3 Fig, 11 Ref.

Descriptors: *Groundwater movement, *Saline water intrusion, *Spatial variation, Density, Finite difference methods, Pressure head.

A numerical code is developed for the solution to the three-dimensional steady state groundwater flow equation in which groundwater density varies with spatial position and is treated as a known spatially dependent parameter. The integrated finite difference grid elements of the numerical code are rectangular when viewed along the vertical direction, but their top and bottom surfaces parallel or are coincident with the interfaces between the geologic strata within the solution region. Conditions that are sufficient for the accuracy of the code are derived. Approximate solutions for pressure head, as determined from the code, are compared for accuracy with several exact analytic test solutions. (Author's abstract)
W84-00087

SIMULATION OF SALT WATER-FRESH WATER INTERFACE MOTION,
Valencia Univ. (Spain).
J. Ferrer Polo, and F. J. Ramos Ramis.
Water Resources Research, Vol 19, No 1, p 61-68, February, 1983. 6 Fig, 13 Ref.

Descriptors: *Saline water intrusion, *Groundwater movement, *Coastal aquifers, Model studies, Mathematical models, Saline-freshwater interfaces, Aquifers, Unconfined aquifers, Confined aquifers.

A mathematical model for saline water intrusion describes the salt water-fresh water motion with a sharp interface. It was used to develop a numerical model (finite difference method) which unconditionally convergent and stable. The numerical model was verified by simulating three cases for which analytical results were known. These were: (1) steady state analytical solution (for two cases, confined and unconfined aquifer), (2) unsteady state solution with variable boundary conditions at the coast, and (3) unsteady state analytical solution including only motion of the interface tip and toe. The numerical model and analytical results agreed well for Case (1) and Case (3). In Case (2) agreement was good close to the interface tip and became less favorable toward the interface toe. (Cassar-FRC)
W84-00116

THE WATER-TABLE OF THE RHINE PLAIN IN ALSACE (LA NAPPE PHREATIQUE DE LA PLAINE DU RHIN EN ALSACE),
Strasbourg-1 Univ. (France). Bureau de L'Environnement.
L. Simler.
Techniques et Sciences Municipales, No 2, p 79-88, February, 1981. 17 Fig, 1 Tab.

Descriptors: *Water table fluctuations, *Groundwater pollution, *Groundwater movement, Alluvial plains, Natural water table, Water table profiles, France, Rhine River, Alsace.

The water table of the Rhine Plain in Alsace, France, is contained in a lamellar alluvion system, which fortunately behaves like a large-scale homogeneous medium. Transmissivity depends only on the thickness of the alluvium. Moreover, the effects of the slow circulation of groundwater and of the rapid displacement of water in the fluvial system interfere with the action of the water table. The water table levels are thus autoregulated, especially since the fluvial system is dense. These interference phenomena explain the mechanisms of pollution, and notably of pollution by chlorides, and may be used for determining the speed of pollution removal when pollution sources are eliminated. (Author's abstract)
W84-00314

2G. Water In Soils

SOIL CRUSTING AFFECTS WATER CONSERVATION AND INFILTRATION,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 3F.
W84-00167

SIMPLE METHOD FOR PREDICTING DRAINAGE FROM FIELD PLOTS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. Y. Parlange.
Soil Science Society of America Journal, Vol 46, No 4, p 887-888, July-August, 1982. 2 Ref.

Descriptors: *Mathematical equations, *Drainage patterns, *Surface tension, *Diffusion coefficient, *Soil water suction, Model studies, Mathematical models, Drainage, Surface drainage, Prediction, Soil water.

A simple method based on analytical solutions of Sisson et al. (1980) for predicting drainage from field plots is proposed. The work of Sisson and colleagues assumes that gravity is primarily responsible for water movement during drainage and neglects the effects of diffusion. The neglect of surface tension effects may lead to significant errors near the soil surface. In the new equation,

profiles at a given time are translated upwards by gamma cm (treated as a constant), where gamma depends on suction near the surface and the time is adjusted to conserve mass. These corrections bring the analytic and numerical solutions closer together. (Geiger-FRC)
W84-00187

SOIL SOLUTE CONCENTRATION DISTRIBUTIONS FOR SPATIALLY VARYING PORE WATER VELOCITIES AND APPARENT DIFFUSION COEFFICIENTS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. Amoozegar-Fard, D. R. Nielsen, and A. W. Warrick.
Soil Science Society of America Journal, Vol 46, No 1, p 3-9, January-February, 1982. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Fate of pollutants, *Soil water, *Salts, *Simulation analysis, *Spatial distribution, *Solute transport, *Monte Carlo method, *Interstitial water, Saline water, Mathematical studies, Soil porosity, Porosity, Permeability coefficient.

Knowledge of the movement of salts and other water-carried constituents through soils is important in maintaining productive agriculture and a healthy environment. A Monte Carlo simulation was performed to predict relative solute concentrations and solute movement properties as affected by the variability of pore water velocity (v) and apparent diffusion coefficient (D). Normal distribution of the natural log of v, the natural log of D, and water-filled porosity were used to determine 2,000 values of relative solute concentrations using the solute flow equation with no soil-solute interaction. Both step and pulse inputs of salt water were simulated. For pulse input, both equal depths and equal infiltration time were studied. Results showed sharp differences between the solute profiles when deterministic values of v are used compared to the average salt profile for 2,000 random values of v. The variability of D was also found to be less important than for v, especially for greater depths. For the pulse input, more salt will occur in the upper part of the profile when 7.5 cm of salt water infiltrate at each point in the field than when 7.5 cm is the average infiltration depth for the whole area. (Geiger-FRC)
W84-00188

PIPE DRAINAGE OF HEAVY SOILS: A FIELD EVALUATION,
Soil Conservation Service, Lincoln, NE.
For primary bibliographic entry see Field 4A.
W84-00191

PRODUCTIVITY OF WESTERN LARCH AND SUBSOIL PERCOLATION RATES ON POOR ACIDIC SOILS,
Montana Univ., Missoula. School of Forestry.
C. Spitzner, and N. Stark.
Soil Science, Vol 134, No 6, p 395-400, 1982. 3 Tab, 21 Ref.

Descriptors: *Soil properties, *Productivity, *Drainage, Saline soils, Percolation, Leaching, Nutrients, *Montana, Subsurface water.

A study was conducted to determine whether variation in the subsurface percolation rate of underlying glacial till significantly affects the nutrient content of the andic surface soil or timber production on the andic soils. Twenty sites were sampled during the summer of 1980, covering a range of three percolation classes. All had ash depths of 18 to 50 cm, covering 160 m of elevational range and receiving an average of 950 to 1125 mm precipitation. All sites had western larches about 50 years of age. Analysis of the data and comparison of means for the various nutrient concentrations in the volcanic ash layers of the soil profiles did not show significant differences with changes in subsurface percolation rates, except for phosphate. Comparable leaching of the volcanic ash occurred on all sites, except for phosphate retention by the ash on the slowly drained soils. Ash on the slowly drained sites tended to be lower in most ions than ash on faster draining sites. Soil nutrients were significantly more abundant in the slowly drained sites. Soil nutrients were significantly more abundant in the slowly drained subsoils. Natural variability among site factors and physical differences in the subsoil may have contributed to this finding. Ion movement is likely to be influenced by the abundance of hydrogen ions in these soils. (Baker-FRC)
W84-00193

'BLUE' SOILS CAUSE COMPLEX DRAINAGE PROBLEMS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. R. Hanson, and L. D. Whittig.
California Agriculture, Vol 34, No 10, p 13-14, October, 1980. 2 Tab.

Descriptors: *Drainage, *Soil chemistry, *Saturated soils, Soil properties, Iron compounds, Hydraulic conductivity, Blue soils, Compacted soils, Soil compaction, Soil saturation, Soil texture, Anaerobic conditions.

Drainage conditions were investigated in an area with brown top soil underlain by blue, blue-gray, and mottled saturated soils. Although the texture of the soils indicated that water movement was adequate for a drainage system, the hydraulic conductivity in the blue layer was extremely low. This low hydraulic conductivity is believed to be the result of reduced iron and high organic matter content of the soil. Under these conditions ferrous hydroxide is formed and precipitated out of the water, forming a gelatinous substance, which compacts the soil. Drainage to oxidize the iron was impossible in this situation because of poor drainage conditions and frequent wetting by rainfall and irrigation. It was suggested that a shallow drainage system be installed only in the top soil to provide a suitable root zone environment for agricultural purposes. (Cassar-FRC)
W84-00299

SOME EFFECTS OF LINEARIZING THE UNSATURATED SOIL MOISTURE TRANSFER DIFFUSIVITY MODEL,
California Univ., Irvine. School of Engineering.
T. V. Hromadka, and G. L. Guymon.
Water Resources Research, Vol 16, No 4, p 643-650, August, 1980. 15 Fig, 2 Tab, 11 Ref.

Descriptors: *Soil water, *Diffusivity coefficient, *Infiltration, Wetting, Finite element method, Crank-Nicolson Model, Galerkin model, Unsaturated flow, Model studies.

Unsaturated soil moisture transfer in a horizontal column was estimated using the Galerkin method combined with the Crank-Nicolson time advance approximation. The Galerkin technique was used for the quasi-linear spatial discretization problem, and the Crank-Nicolson technique was used with a diffusivity coefficient update method. For the constant diffusivity coefficient problems a modified capacitance matrix scheme significantly improved results over the standard finite element capacitance matrix. Five methods of estimating quasi-constant soil water diffusivity equivalents were evaluated. The resulting moisture content profiles from both the modified and unmodified capacitance matrix formulations were compared with the known Philip's solution for each of the five quasi-constant diffusivity computational schemes. Best results were obtained with the unmodified finite element capacitance matrices based values of diffusivity coefficients evaluated as the mean parabolic value of the state variable (water content). (Cassar-FRC)
W84-00302

2H. Lakes

SENSITIVITY OF OREGON'S CASCADE LAKES TO ACID PRECIPITATION,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
P. O. Nelson, and G. K. Delwiche.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111780, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-85, Oregon State Univ., Corvallis, September 1983. 55 p, 7 Fig, 3 Tab, 35 Ref, 3 Append. OWRT A-061-ORE(1), 14-34-0001-2139.

Descriptors: *Acid rain, Precipitation, Lakes, Oligotrophic lakes, Lake contamination, Chemical properties, *Carbonates, *Oregon carbon, *Dissolved organic carbon, Dissolved aluminum, *Dilute-lake chemistry, Buffering capacity, *Oregon, Oregon cascades, Oregon lakes, *Oregon cascade lakes.

Susceptibility to acidification and present extent of anthropogenic acidification were studied for 63 Oregon Cascade lakes in 1982. Chemical parameters included pH, conductivity, alkalinity, calcium, magnesium, sodium, potassium, dissolved silica, chloride and sulfate. Major ion balances were calculated. Analyses for total organic carbon, fluoride and aluminum were performed in some cases. The lakes have extremely dilute ionic compositions. Average conductivity was 17.0 umhos/cm. Average laboratory-equilibrated pH was 6.96. Alkalinities averaged 137.6 ueq/l; 25 lakes had alkalinities of less than 50 ueq/l. Calcium was the major cation (36%) and bicarbonate was the major anion (82%) present. Aluminum and sulfate concentrations were extremely low. The carbonate system was found to be the dominant buffer system. Extremely low alumunim and total organic carbon concentrations indicate the minor contribution of aluminum hydrolysis species and weak organic acids to the overall acid neutralizing capacity of these waters. The calcium-to-bicarbonate ratio and the low dissolved aluminum and sulfate concentrations show that anthropogenic acidifications is undetectable to date. Oregon's Cascade lakes do not presently have an acid precipitation problem but are extremely susceptible to acidification. The lakes can serve as a chemical benchmark to compare with acidified lakes of similar volcanic geology.
W84-00038

EFFECT OF LOW PH ON THE CHEMICAL COMPOSITION OF AQUATIC INVERTEBRATES FROM TUNDRA PONDS AT THE SMOKING HILLS, N.W.T., CANADA,
Toronto Univ. (Ontario). Dept. of Botany.
M. Havas, and T. C. Hutchinson.
Canadian Journal of Zoology, Vol 61, No 1, p 241-249, 1983. 6 Fig, 3 Tab, 21 Ref.

Descriptors: *Hydrogen ion concentration, *Acidic water, *Crustaceans, *Aquatic insects, *Tundra, *Alkaline water, Ponds, Chemical properties, Sulfates, Mortality, Daphnia, Sodium, Chlorine, Potassium, Chemical reactions, Aluminum, Northwest Territory.

The effect of low pH due to natural sulfate fumigation on the elemental composition of crustaceans and insect larvae collected from strongly acidic and alkaline tundra ponds at the Smoking Hills, Northwest Territory were examined. Analysis of mortality rates suggested that crustaceans Daphnia middendorffiana, Diaptomus arcticus, Branchinecta paludosa, Lepidurus articus and Diptera Orthocladuis consobrinus were more sensitive to low pH than were insect larvae due to their inability to maintain high internal levels of sodium (Na), Chlorine (Cl), and potassium (K). K levels were also low in dead and moribund Daphnia, but not in the more tolerant Diptera larvae. D. middendorffiana recovered following a brief exposure to pH 4.0 in which Na and Cl concentrations returned to their original levels. Acid-exposed Daphnia became infected by pathogenic fungi. Water chemistry also altered the chemical composition of some of the aquatic invertebrates studied, probably due to the elevated aluminum levels in the acidified pond water. (Geiger-FRC)
W84-00073

EXPERIMENTAL STUDIES ON THE FACTORS LIMITING TROPOCYCLOPS PRASINUS (FISCHER) 1860 IN AN OLIGOTROPHIC LAKE,

British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
A. Peacock, and W. J. P. Smyly.
Canadian Journal of Zoology, Vol 61, No 1, p 250-265, 1983. 13 Fig, 10 Tab, 50 Ref.

Descriptors: *Copepods, *Cyclops, *Population dynamics, *Population density, *Oligotrophic lakes, Temporal distribution, Crustaceans, Aquatic populations, Predation, Seasonal variation, Food chains, Mortality, *British Columbia, Placid Lake, Gwendoline Lake.

Factors affecting the relative abundances of Tropocyclops prasinus and Cyclops bicuspidatus thomasi in a small oligotrophic lake (Placid Lake) in coastal British Columbia were examined in laboratory feeding experiments. T. prasinus, which is abundant in the lake, was omnivorous in the later instars but showed no signs of cannibalism or predation on other microcrustaceans. Adult diets of T. prasinus and C.b. thomasi (rate in the lake) did not overlap; however, seasonal abundance peaks revealed a temporal segregation of the anupliar instars of both cyclopoid copepods. Chaoborus flavicans ate more C.b. thomasi than T. prasinus, but in laboratory beakers, in the absence of Chaoborus, C.b. thomasi always outnumbered T. pasinus after 50 or 100 days. Results of large scale exposure experiments showed that lake densities of C.b. thomasi could limit the abundance of T. prasinus in Placid Lake. T. prasinus naupliar mortality was high, even in the absence of C.b. thomasi. In the presence of C.b. thomasi, mortality of nauplius 4 to copepodid I instars was greatly increased. (Geiger-FRC)
W84-00080

THE MACROINVERTEBRATE FAUNAS OF RIFFLES AND POOLS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
P. Logan, and M. P. Brooker.
Water Research, Vol 17, No 3, p 263-270, March 1983. 2 Fig, 5 Tab, 38 Ref.

Descriptors: *Invertebrates, *Aquatic habitats, *Population density, Macroinvertebrates, Riffles, Pools, Aquatic populations, Aquatic insects, Insects, Stream biota, Classification, Species composition.

Macroinvertebrate population data from 17 studies of rivers (mostly upland) in North America and the United Kingdom were examined for differences in fauna inhabiting pools and riffles. Most of the numbers and taxa were similar in both habitats, but Simulium and Corixa were characteristic of riffles and pools, respectively. Riffles had significantly higher population densities than pools. Generally, Ephemeroptera accounted for a higher proportion of the total density in riffles than in pools. Diptera covered a higher proportion in pools than in riffles. Ephemeroptera represented the only taxa to show significant differences in density between the two habitats, riffles supporting higher densities than pools. The overall ratio for total density (riffles/pools) was 1.1. Only Baetidae and Simuliidae families showed significant differences in density, riffle density being greater than pool density. Results of this study indicated that sites will probably be classified correctly with respect to biological monitoring whether samples are collected in riffles or pools. However, these conclusions should not be applied to lowland rivers, for which insufficient data exist. (Cassar-FRC)
W84-00132

SELF-PURIFICATION OF WATER AS A FUNCTION OF PHYSIOLOGY OF MACROPHYTES,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
K. B. Yakubskiy, and A. I. Merezhko.
Hydrobiological Journal, Vol 18, No 2, p 63-68, 1982. 1 Fig, 2 Tab, 36 Ref.

Descriptors: *Macrophytes, *Water purification, Self-purification, Water quality, Water quality control, Lakes, Reservoirs, Aquatic plants, Pondweed, Reeds, Oxygen, Nutrients, Calcium, Minerals, Potassium, Chlorine, Biomass.

In a body of water, self-purification is closely related to the vital activity of macrophytes and their biological pecularities. Common reed, as a typical representative of subaerial littoral vegetation, exhibits high rates of photosynthesis and active absorption of nitrogen and silicon. It forms a large phytomass, the quantity of which is closely related to the presence of nutrients in the substrate, their absorption, and thus the self-purification of water and high water quality. The phytosynthesis in perfoliate pondweed (submerged vegetation) proceeds at a lower rate, but gas exchange occurs within the water, so that its aeration capacity is higher than that of reed. Pondweed also has high absorption capacity in that it absorbs double the quantity of mineral elements per unit of generated biomass compared to the reed, particularly such elements as potassium, calcium and chlorine. For intelligent use of these macrophytes as biofilters both under natural conditions and in artificial water purifiers, allowance must be made for their biology, particularly their aeration and absorptive capacity. (Baker-FRC)
W84-00144

APPLICABILITY OF CERTAIN COMMON BIOINDICATION METHODS TO EVALUATION OF WATER QUALITY IN THE LITTORAL ZONE OF THE KREMENCHUG RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5A.
W84-00146

SELECTIVE FEEDING BY ZOOPLANKTON: IMPLICATIONS FOR LAKE PRODUCTIVITY,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
A. Konopka, K. M. Brown, and C. R. Lovell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113679, Price codes: A07 in paper copy, A01 in microfiche. Technical Report No 161, September 1983. 126 p, 11 Fig, 70 Tab, 76 Ref. OWRT B-127-IND(1), 14-34-0001-1225.

Descriptors: *Bacteria, *Phytoplankton, *Zooplankton, *Primary productivity, Lakes, Photosynthesis, *Food chains, Food webs, *Indiana, Crooked Lake, Little Crooked Lake.

The relationship between phytoplankton, bacteria, and zooplankton activities and distributions was studied in two Indiana lakes: Crooked and Little Crooked. Primary production in the metalimnion was an important source of fixed carbon in these lakes. In Crooked Lake, metalimnetic production accounted for 30-45% of the total production, during the summers of 1979-1981. Changes in the vertical distribution of biomass in the water column had a greater effect upon metalimnetic production than differences in water transparency or incident solar radiation. Excretion of organic carbon by phytoplankton populations is a potentially important source of carbon for heterotrophic bacteria. The photosynthetic rates of water samples were proportional to light intensity and increased from 1.42 to 3.14 mg C mg super -1 chlorophyll a hr super -1 within a range of light intensities from 65 to 150 mu E m super -2 sec super -1. Elevated oxygen concentrations in samples incubated at 150 mu E m super -2 sec super -1 decreased rates of both photosynthesis and excretion. The photosynthetic rate increased from 3.0 to 5.0 mg C mg super -1 chlorophyll a hr super -1 as the pH was raised from 7.5 to 8.8. Calculation of total primary production using a numerical model showed that whereas 225.8 g C m super -2 was photosynthetically fixed during the period between May 12 to August 24, 1982, only g C m super -2 was excreted by phytoplankton. Heterotrophic bacterial activity in the two lakes generally correlated very well with the distribution of phytoplankton. Bacterial activity was primarily associated with planktonic bacteria rather than cells attached to particles. Several zooplankton species found in the lake were capable of ingesting bacteria and unicellular cyanobacteria but could not feed on filamentous cyanobacteria, the most important phytoplankton in the lakes.
W84-00165

REPORT OF THE WORK GROUP ON WETLANDS (INCLUDING RICE) AND AQUATIC SYSTEMS,
K. R. Reddy, V. Montecino, A. J. Holding, U. Irmler, and P. S. C. Rao.
Plant and Soil, Vol 67, No 1-3, p 421-424, 1982. 1 Tab, 5 Ref.

Descriptors: *Wetlands, *Rice, *Nitrogen, Research priorities, *South America, Lakes, Rivers.

A summary report on a wetlands study reveals that the area (in sq km) occupied by various fresh water ecosystems in Latin America is: lakes, 62,000; river basins; 8.1 million; and rice fields, 54,000 (upland) and 21,000 (irrigated). Of the research priorities listed, nitrogen budgets and associated model studies are of primary importance. Using data from the southern U.S., N fluxes were estimated for rice ecosystems in Latin America: influx, 159-325 kg N per ha (largest amounts from fertilizer and soil N mineralization); output, 116-335 kg N per ha (largest amounts from harvest and denitrification). (Cassar-FRC)
W84-00171

THE SPECIES AND SIZE COMPOSITION OF TROPICAL FRESHWATER ZOOPLANKTON WITH SPECIAL REFERENCE TO THE ORIENTAL REGION (SOUTH EAST ASIA),
Waterloo Univ. (Ontario). Dept. of Biology.
C. H. Fernando.
Internationale Revue der Gesamten Hydrobiologie, Vol 65, No 3, p 411-426, 1980. 2 Fig, 6 Tab, 108 Ref.

Descriptors: *Zooplankton, *Lakes, *Species composition, Asia, India, Tropical regions, Temperate zone, Clacoderans, Copepods, Rotifers, Species diversity, Daphna.

The zooplankton population of Southeast Asia (encompassed by India and Nepal in the west, the Philippines in the east, and Indonesia in the south) showed a gradual change from the northern and southern temperate regions to the tropical region. Data was gathered from over 2500 samples collected from 1200 localities during 1968-1977. The number of Cladocera and Copepoda species was much less in the tropical region than in the temperate regions. Daphnia were scarce and small in the tropics and increased in size, number, and diversity toward the temperate zones. This was also true for Holopedidae, Leptodoridae, and Polyphemidae. The littoral zooplankton, Eruycerus and Saycia, were absent or very rare in the tropics compared with the temperate zones. Only two cyclopoids, the herbivorous Thermocyclops crassus and the carnivorous Mesocyclopsleukarti, were common in the tropical region. The most common rotifers were Brachionus and Keratella tropica. Endemic and unexpected Cladocera reported were Alona macronyx Daday, Chydorus faviformis Birge, Alonella nana Baird, and Indialona ganapati Petrovski. (Cassar-FRC)
W84-00296

SEASONAL CYCLES OF ZOOPLANKTON AND RELATED PHYTOPLANKTON DEVELOPMENT IN THREE SHALLOW, MESOTROPHIC LAKES IN NORTHERN CANADA,
Alberta Environmental Center, Vegreville.
J. W. Moore.
Internationale Revue Der Gesamten hydrobiologie, Vol 65, No 3, p 357-378, 1980. 7 Fig, 4 Tab, 49 Ref.

Descriptors: *Zooplankton, *Population density, *Food habits, Lakes, Phytoplankton, Seasonal variation, Mesotrophic lakes, Canada, Temperature effects, Subarctic zone, Grace Lake, Long Lake, Madeline Lake.

The seasonal cycles of zooplankton and phytoplankton development were studied during April 1978 to April 1979 in three shallow, mesotrophic lakes (Grace, Long, and Madeline) in northern Canada. The lakes were similar in nannoplankton density (50-450 mg per cu m in summer), net phytoplankton density (200-1600 mg per cu m in summer), temperature, depth (11-17 m), oxygen

concentration, and phosphorus levels. Most common nannoplankton species were Nannochloris bacillaris, Rhodomonas minuta var. nannoplanktonia, Ochromonas, and other phytoflagellates. Main phytoplankton taxa were Dinobryon and filamentous cyanophytes. The seasonal changes in zooplankton species (Keratella cochlearis, Kellicottia longispina, Polyarthra vulgaris, Polyarthra remata, Cyclops, Diaptomus ashlandi, Daphnia longiremis, and Codonella cratera) were similar in the three lakes. Changes in densities of these species were not statistically correlated with fluctuations in nannoplankton availability, implying that food did not limit development. Although predatory copepods were abundant, they had no measurable impact on the main species. It was concluded that temperature was the most important factor regulating the seasonal cycles and the population sizes of most zooplankton. (Cassar-FRC)
W84-00305

TROPHIC UPSURGE IN NEW RESERVOIRS: A MODEL FOR TOTAL PHOSPHORUS CONCENTRATIONS,
Department of the Environment, Sainte-Foy (Quebec).
Y. Grimard, and H. G. Jones.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 11, p 1473-1483, 1982. 5 Fig, 1 Tab, 38 Ref.

Descriptors: *Reservoirs, *Phosphorus, Nutrients, Model studies, Trophic level, Canada, Canadian Shield.

A model is presented for total phosphorus concentrations during both the trophic upsurge and depression phases in new reservoirs. The model was developed by a convolution of the rate of phosphorus leaching from flooded lands and the rate of reservoir filling. Model parameters for phosphorus sedimentation and leaching coefficients were estimated from data available on the Smallwood Reservoir (impoundment 1971) in Labrador. The model was then applied to predict phosphorus concentrations during the trophic upsurge phase in the La Grande-2 Reservoir (impoundment 1978) in the James Bay region of Quebec. Because the sparse data available on other new or old reservoirs during the trophic upsurge phase does not permit an analysis of the confidence limits in model output, discussion of the calculated values of model parameters and their relationship to the real phenomena are included. An evaluation of the rates of phosphorus leaching from various lands has shown indirectly that the proposed model approximates the dynamics of new reservoir phosphorus concentrations. It is concluded that the model as defined bears some promise as the base for an empirical model, although compatible data on reservoir systems are rare. Confidence in the model is enhanced, as the values of certain model parameters are of the same order of magnitude as those calculated by independent means. The model has a good potential as an empirical predictive tool in the management of large new reservoirs on the Canadian Shield. (Baker-FRC)
W84-00315

2I. Water In Plants

THE EFFECT OF MOISTURE STRESS ON CORN PRODUCTION IN THE HIGH PLAINS,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W84-00163

SIMULATING PLANT WATER UPTAKE IN MOIST, LIGHTER TEXTURED SOILS,
Georgia Agricultural Experiment Stations, Athens.
E. W. Tollner, and F. J. Molz.
Transactions of the ASAE, Vol 26, No 1, p 87-91, 99, 1983. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Soil properties, *Soil-water-plant relationships, Model studies, Richard's equation, Mathematical studies, Mathematical equations, Permeability.

Mathematical models for simulating water transport in soils containing roots have been extremely useful for increasing the understanding of soil-water-plant relationships. Such models are currently being used in the design of various water and waste management systems where soils are relatively wet much of the time. Consideration is given to the case of one-dimensional, vertical movement of water in a soil containing the roots of transpiring plants. Mathematical complexity is thus kept to a minimum while the basic physical principles are described. The results can be generalized to multi-dimensional situations. A physically based root extraction relation for use in Richard's equation is proposed. The extraction function assumes that the water uptake rate per unit volume of soil is proportional to the product of contact length per unit soil volume, root permeability per unit length and water potential difference between soil annd root xylem pot volume of soil is proportional to the product of contact length per unittential, which is assumed to be constant over the root zone. Herkelrath's factor, which accounts for reduced root-soil-water contact as water is removed, was included. Thus the model should be applicable in any system involving lighter texture soils kept relatively wet. Model predictions compared favorably with the results of a previously performed experiment. (Baker-FRC)
W84-00181

2J. Erosion and Sedimentation

DENSITY GRADIENT ANAYLSIS OF SUSPENDED MATTER,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. W. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111673, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, October 1983. 33 p, 14 Fig, 3 Tab, 25 Ref. OWRT A-085-CAL(1).

Descriptors: *Centrifugation, Separation techniques, *Sediment sorting, *Estuaries, *Algae, Sediment-water interfaces, Bottom sediments, Sediment concentration, Marine concentration, Suspended concentration, Toxicity.

Development of a simple and inexpensive density gradient centrifugation method, utilizing silica sols, for separating and isolating various fractions of suspended matter and bottom sediments was begun. There is presently no effective means for fractionating suspended material in natural waters into its natural components. The technique will be especially useful for researchers in estuarine productivity and toxicology. The influence of preservatives and density shift reagents on the separating and resolving powers of the centrifugation method has been analyzed. In addition the interaction between the method and the density shift reagents and preservatives on analysis of chlorophyll a, proteins, and carbohydrates was examined. Preliminary results indicate that the development of suitable methodology will require considerable additional effort. The technique has demonstrated that it is an important means of separating certain algal associations. (Snyder-California)
W84-00027

SEDIMENT TRANSPORT BY WAVES AND CURRENTS,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
M. C. Quick.
Canadian Journal of Civil Engineering, Vol 10, No 1, p 142-149, 1983. 6 Fig, 13 Ref.

Descriptors: *Sediment transport, *Wave action, *Water currents, Laboratory studies,.

The combined action of waves and currents on sediment transport was studied in a laboratory flume with a sand bottom, wave paddle, and current generator. Sediment transport direction was mainly determined by the direction of the wave movement, even in the presence of adverse currents, until waves started to break. Mass transport wave velocity increased in the presence of adverse currents, so that sediment still moved slowly in the direction of wave advance. Waves moving into a region of stronger adverse currents became steeper. When they began to break, the mass transport velocity at the bed fell to zero, and sediment transport then followed the direction of the adverse current. A transport power relationship was developed to predict the sediment transport rate. This agreed with the measured sediment transport rates. (Cassar-FRC)
W84-00069

SEMI-EMPIRICAL CORRELATIONS FOR FINE AND COARSE COHESIONLESS SEDIMENT TRANSPORT,
Lamar Univ., Beaumont, TX.
P. A. Mantz.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 75, No 1, p 1-33, 1983. 6 Fig, 13 Tab, 28 Ref.

Descriptors: *Bed load, *Sediment load, *Sediment transport, *Theoretical analysis, *Resistance, *Mathematical, Sediment distribution, Streamflow, Suspended load, Shear stress, Flow velocity.

The equilibrium sediment transport, bedform development and hydraulic resistance for three grades of almost equal-sized silica solids were studied under three flow depths and six conditions of average flow velocity. Sediment transport was analyzed according to the streampower theory developed by Bagnold, assuming that the rate of applied flow energy was dissipated partly by the friction of moving bed load solids, partly by the turbulence associated with bedforms, partly by the gravitational settling of suspended load solids, and partly by the friction of the unimpeded flow. Correlations were generated for the work rates associated with the moving bed load or suspended load and the streampower excess, which excludes that required for incipient transport or incipient suspension. Field data were compared with laboratory data, and bed load data were abstracted from a recent collation by Bagnold. Suspended load data were abstracted from river data of the United States Geological Survey. The present research expands the three classes of rivers according to Bagnold to take into account coarse and fine sediments, shallow and deep flows and streams of non-rectangular cross-section or a meandering stream. (Geiger-FRC)
W84-00077

DETERMINATION OF BEDLOAD TRANSPORT USING NATURALLY MAGNETIC TRACERS: FIRST EXPERIENCES AT SQUAW CREEK, GALLATIN COUNTY, MONTANA,
Freie Univ. Berlin (Germany, F.R.). Inst. fuer Physische Geographie.
P. J. Ergenzinger, and S. G. Custer.
Water Resources Research, Vol 19, No 1, p 187-193, February, 1983. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Sediment transport, *Bed load, *Magnetic studies, Tracers, Squaw Creek, *Montana, Measuring instruments.

A detector which records the movement of naturally magnetic pebbles and cobbles in a stream bed was evaluated in Squaw Creek, Montana, during a 10-year flood in May 1981. Particles over 32 mm in diameter were detectable by the instrument. Correction factors accounting for the 85% of pebbles which were not magnetic, the smaller particles not detected (2/3 of total particles), and width of the creek allowed estimation of the total bedload transport. The bedload accounted for 66% of the total solid material (3400 metric tons) leaving the drainage basin during the flood. The rate of transport of suspended load varied from 200-400 kg per hour at the onset to 146,000 kg per hour at the peak stage. The peak in suspended load corresponded with the peak in water discharge. The rate and timing of bedload transport did not correspond as well to water discharge. (Cassar-FRC)
W84-00084

Group 2J—Erosion and Sedimentation

A DECISION MODEL TO PREDICT SEDIMENT YIELD FROM FOREST PRACTICES,
National Forests in North Carolina, Asheville.
For primary bibliographic entry see Field 4C.
W84-00099

MODELING UPLAND EROSION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
R. M. Khanbilvardi, A. S. Rogowski, and A. C. Miller.
Water Resources Bulletin, Vol 19, No 1, p 29-35, February, 1983. 4 Fig, 2 Tab, 24 Ref.

Descriptors: *Model studies, *Erosion, Mathematical equations, Universal soil loss equation, Rills, Interrills, Sediment transport, Sedimentation.

A computer model of soil loss on an upland watershed has been developed from the continuity considerations for sediment transport and from equations describing rill and interrill erosion. The model is based on dividing the upland area into a grid containing rill and interrill zones, on the Universal Soil Loss Equation, and on equations describing detachment and transport capacity of rill flow. The USLE estimates the sediment load from the contributing areas. The location and amount of total erosion and deposition are determined by comparing the transport and detachment capacity of rill flow for specific storms. The model considers the mechanics of the erosion process and can serve as a basis for reservoir and channel design and land use planning. Interception, though neglected in the numerical example presented, is included in the model. (Baker-FRC)
W84-00104

EXTREMAL HYPOTHESES FOR RIVER BEHAVIOR,
Canterbury Univ., Christchurch (New Zealand). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W84-00129

BIOGEOCHEMICAL CYCLING IN AN ORGANIC-RICH COASTAL MARINE BASIN-3. DISSOLVED GAS TRANSPORT IN METHANE-SATURATED SEDIMENTS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 2L.
W84-00153

TRANSPORT OF SAND-SIZED SEDIMENT ALONG CROP-ROW FURROWS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. D. Meyer, B. A. Zuhdi, N. L. Coleman, and S. N. Prasad.
Transactions of the ASAE, Vol 26, No 1, p 106-111, 1983. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Sediment transport, *Erosion control, Sand, Rainfall-runoff relationships, Sedimentation, Erosion.

Sediment transport capacity was evaluated along simulated crop row furrows as influenced by furrow gradient, flow rate, sediment size and the presence or absence of rainfall. Only sand-sized sediment of single-particle density was studied. Four sand size groups averaged 77, 151, 302, and 603 micrometers for furrow gradients of 0.2, 1.0, 2.5, and 5.0% at flow rates of about 26, 39, 52 and 65 kg/min with and without intense simulated rainfall. Sediment tranport capacity increased rapidly as furrow gradient increased. The capacity was very small at 0.2%, but it became quite large at gradients above 1%. Transport capacity increased as flow rate increased, but the effect was less than that of furrow gradient. Transport capacity generally increased as particle size decreased below 300 micrometers. Rain falling on the furrow flow did not appreciably affect sediment transport for the conditions tested. The mode of sediment transport changed from isolated barchan dunes to transverse bars to streaky sheets of sediment as the furrow gradient increased. Development of the streaky sheet mode of transport was delayed by rainfall, and the change from bars to streaks occurred at about 1% gradient. (Baker-FRC)
W84-00186

A SMALL-SCALE FLOOD PLAIN,
Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
D. A. Hughes, and J. Lewin.
Sedimentology, Vol 29, No 6, p 891-895, 1982. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Flood plains, *Deposition, *Sediment sorting, *Sedimentation, Deltas, Suspended sediments, Alluvial deposits, Sediment distribution, Sediment transport, Overflow, Levees, Sedimentology, *Wales, River Rheidol.

A miniature flood plain was formed at a gravel extraction and washing plant on the River Rheidol, Wales. Washing water with high concentrations of fine sediment was channeled into a pit producing a small-scale delta, channel, and flood plain system about 9 m wide. The system developed levees, crevasse splays, and flood basins. Overbank sedimentation was dominant. Median sediment size decreased exponentially with distance from the channel center. At a meander bend coarser sediments were deposited on the outside of the bed. Sorting also improved with distance from the channel. The finest sediments were deposited in the stiller and deeper water. Deposits in the flood plain were laminated or very thinly bedded, without cross stratification. This was a result of variations in sediment supply from different gravels and relocation of crevasses and overflows. (Cassar-FRC)
W84-00189

HIGH SEDIMENT YIELDS FROM MAJOR RIVERS OF THE WESTERN SOUTHERN ALPS, NEW ZEALAND (DISCUSSION AND REPLY),
J. Adams, and G. A. Griffiths.
Nature (London), Vol 287, No 5777, p 88-89, September 4, 1980. 10 Ref.

Descriptors: *Erosion rates, *Suspended sediments, *Mathematical studies, Sedimentation, Suspended load, Rivers, *New Zealand, Flow characteristics, Dissolved solids, Bed load, Sediment load.

This response to a previous article by G. A. Griffiths (Nature, Vol. 282, p 61-63, 1979) suggests that Griffiths took too little heed of published data on sediment yields from major rivers of the western Southern Alps in New Zealand and underreported the suspended load data available. Griffiths reported data on suspended sediment yields from fewer rivers than had previously been reported and applied a traditional approach to calculation of suspended loads which had been questioned by the commentator. The commentator and the author used the same data on sediment loads, but reached significantly different estimates of loads in some cases. The author responds that the commentator had made assumptions in earlier studies which were not substantiated and that data which he presented was not always adequately identified. Griffiths charges that Adams did not make good use of his data, that some evaluations of the data were arbitrary, and that the results of the earlier study were not repeatable. (Carroll-FRC)
W84-00190

2K. Chemical Processes

EFFECT OF LOW PH ON THE CHEMICAL COMPOSITION OF AQUATIC INVERTEBRATES FROM TUNDRA PONDS AT THE SMOKING HILLS, N.W.T., CANADA,
Toronto Univ. (Ontario). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W84-00073

CHEMICAL COMPOSITION AND SPATIAL VARIATION OF BULK PRECIPITATION AT A COASTAL PLAIN WATERSHED IN SOUTH CAROLINA,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 2B.
W84-00108

MINERAL PRECIPITATION IN NORTH SLOPE RIVER ICINGS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. K. Hall.
Arctic, Vol 33, No 2, p 343-348, June, 1980. 3 Fig, 12 Ref.

Descriptors: *Calcium carbonate, *Groundwater, *Chemistry of precipitation, *Rivers, *Ice formation, Calcium compounds, Chemical properties, Ice, Arctic zone.

Patches of powdered calcium that were found on icings (aufeis) in the Canning and Shaviovik Rivers in northern Alaska suggest that much of the water feeding the aufeis fields comes from depth and has flowed through calcareous bedrock. Aufeis forms in winter at or below the point of groundwater discharge or when river water is forced up through cracks in river ice. Calcium carbonate is excluded during groundwater freezing and accumulates as slush on top of the ice as the aufeis ablates during the melt season. During a July 1978 field study, four patches of calcium carbonate covering about 0.1% of the total area of the Canning River aufeis were observed. If similar percentages of calcium carbonate precipitate were present on other major aufeis fields on the eastern North Slope, about 18000 cu m of calcium carbonate may be present during a given year in these aufeis fields. The majority of this precipitate is deposited into the Arctic Ocean via river flow. (Geiger-FRC)
W84-00301

NITRATE DEPLETION IN A SECOND-ORDER MOUNTAIN STREAM,
Southeastern Forest Experiment Station, Asheville, NC. Coweeta Hydrologic Lab.
W. T. Swank, and W. H. Caskey.
Journal of Environmental Quality, Vol 11, No 4, p 581-584, October-December, 1982. 2 Fig, 5 Tab, 20 Ref.

Descriptors: *Denitrification, *Nutrients, *Sediments, Coweeta Hydrological Laboratory, North Carolina, Forest watersheds, Streams, Nitrogen, Logging, Clear-cutting.

Denitrification was studied in Coweeta Hydrological Laboratory, a 2270 ha hardwood forest site in the Appalachian Mountains of North Carolina, for 4 years starting June 1976. During this period logging roads were cut, resulting fills and cuts were stabilized with seeding and liming, and logging was conducted (first half of 1977). Within-stream depletions of nitrate-N from upper to lower reaches of the second-order stream were 127% of total nitrate-N discharged at the outlet the first year, and 99%, 42%, and 5% in succeeding years. Nitrate-N depletion was 3.3 kg the first year, and 27.9, 32.4, and 3.9 kg in succeeding years. Denitrification in the sediment, measured by enzyme assay, produced a loss of 1.7 kg N during the final year of the study. This suggests that sediment denitrification is a major pathway for nitrate-N loss. Neglect of this factor in studies of N dynamics can result in underestimation of N losses in streams. (Cassar-FRC)
W84-00327

2L. Estuaries

DEGRADATION OF ATRAZINE IN ESTUARINE WATER/SEDIMENT SYSTEMS AND SOILS,
Salisbury State Coll., MD.
For primary bibliographic entry see Field 5B.
W84-00018

OLIGOCHAETES AS INDICATORS OF POLLUTION IN THE HUMBER ESTUARY, WITH SPECIAL REFERENCE TO TUBIFICOIDES BENEDENI,

Anglian Water Authority, Huntingdon (England). Lincolnshire River Div.
For primary bibliographic entry see Field 5A.
W84-00025

EFFECTS OF LIGHT, TEMPERATURE AND SALINITY ON THE PHOTOSYNTHETIC PATTERN IN AN ESTUARINE PHYTOPLANKTER FROM CHESAPEAKE BAY,
Agricultural Research Service, Beltsville, MD.
D. E. Terlizzi, and E. P. Karlander.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111871, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Technical Report No 72, Univ. of Maryland, College Park, August 1983. 22 p, 7 Fig, 27 Ref. OWRT A-059-MD(1), 14-34-0001-2122.

Descriptors: Light, Temperature, *Salinity, *Photosynthesis, *Phytoplankton, Interactions, Stress, Protein, Lipid, Polysaccharide, Free metabolites, *Chesapeake Bay, *Maryland.

The effects of the variables; light intensity, temperature, and salinity on the growth rate and the pattern of NaH super 14 CO sub 3 photoassimilation in a coccoid nanoplankter from the Chesapeake Bay (UTEX 1998) were examined. While growth rates were depressed in some instances as a result of a change in medium composition, results generally support earlier conclusions that this organism has a relatively high temperature optimum and favors moderate salinities. Although the response to stress observed by other workers of an enhanced relative incorporation of super 14C into the protein fraction is not always observed, it does occur at 15C and 35 o/oo at all light intensities examined and at 30C under the same light intensities and salinity. In comparing the super 14C fractionation data with growth rate, several trends were observed: (1) Protein super 14C generally increased with increasing growth rate at 15C, (2) Polysaccharide super 14C tended to increase with growth rate at 15 and 30C, but optima at intermediate growth rates were observed at 20C, (3) super 14C incorporation into the lipid fraction decreased with increasing growth rate, (4) Free metabolite super 14C decreased with increasing growth rate except at 20C. The data demonstrate that trends in the photosynthetic pattern as a function of growth rate are regulated by the major physico-chemical parameters of the estuarine environment.
W84-00047

A TWO-DIMENSIONAL NUMERICAL MODEL OF ESTUARINE CIRCULATION USING CUBIC SPLINES,
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
P. Wang, and R. Kahawita.
Canadian Journal of Civil Engineering, Vol 10, No 1, p 116-124, 1983. 10 Fig, 11 Ref.

Descriptors: *Saline water intrusion, *Tidal effects, *Water circulation, Mixing, Estuaries, Spline function, Model studies, Great Whale River, Stratification, *James Bay region.

Velocity and salinity distributions along an estuary have been described by a two-dimensional, laterally integrated numerical model. Governing equations, which express the dynamics of a partially mixed estuary, consist of continuity, momentum balance, and salt and/or heat balance equations, together with an equation of state. They are solved by a finite difference method combined with spline functions. The model was applied to a study of the Great Whale River, James Bay, Canada. The effects of stratification on the salinity distribution were determined. Computed vertical velocity profiles corresponded with the observed dominant upstream current in the lower layers even at ebb tide. At high tide the flow at the river mouth reverses completely. Field data for calibrating this model is not yet available. (Cassar-FRC)
W84-00070

SOME HYDROTECHNICAL PROBLEMS RELATED TO THE CONSTRUCTION OF A CAUSEWAY IN THE ESTUARY OF THE PETITCODIAC RIVER, NEW BRUNSWICK: DISCUSSION,
Northwest Hydraulic Consultants, North Vancouver (British Columbia).
For primary bibliographic entry see Field 6G.
W84-00081

BIOGEOCHEMICAL CYCLING IN AN ORGANIC-RICH COASTAL MARINE BASIN-3. DISSOLVED GAS TRANSPORT IN METHANE-SATURATED SEDIMENTS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
G. W. Kipphut, and C. S. Martens.
Geochimica et Cosmochimica Acta, Vol 46, No 11, p 2049-2060, 1982. 9 Fig, 4 Tab, 36 Ref.

Descriptors: *Seasonal variation, *Nitrogen, *Radon, *Marine sediments, *Radioactive tracers, *Methane, *Ebullition, *Coastal waters, *Argon, Bights, Estuaries, Radioisotopes, Sediment transport, Sediment-water interfaces, Geochemistry, *North Carolina, Cape Lookout Bight.

A seasonal study of the transport processes controlling dissolved gas distributions in the sediment of a small marine basin, Cape Lookout Bight, North Carolina, was conducted to identify seasonally varying mechanisms of dissolved gas sediment-water exchange and to quantify rates of stripping dissolved gases from sediments during ebullition. Results showed that transport of dissolved gases in the anoxic sediments is controlled by diffusion and bubble ebullition and follows a seasonal cycle. Seasonal profiles of methane, nitrogen, argon and radon 222 gases and direct gas flux measurements showed that ebullition dominates the flux of all dissolved gases across the sediment-water interface during the summer months and is important on an annual basis. Transport in the upper 6-8 cm of sediment appears to be controlled by molecular diffusion of gases, while at greater depths it is controlled by diffusion in winter and ebullition in summer. Rates of stripping of dissolved gases within the methane production zone averaged 3-5%/day. Sediments of the bight are never at saturation with respect to the major gases present in seawater due to summer ebullition. Research at other sites suggests that ebullition may be an important transport process in many coastal sediments, and may serve as a mechanism for the transport of volatile reduced compounds between the atmosphere and anoxic sediments. (Geiger-FRC)
W84-00153

SOURCES, SINKS, AND DISTRIBUTION OF ORGANIC CARBON IN THE ST. LAWRENCE ESTUARY, CANADA,
Bedford Inst. of Oceanography, Dartmouth (Nov Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 5B.
W84-00155

A NUMERICAL MODEL OF CIRCULATION IN A CONTINENTAL SHELF-SILLED FJORD COUPLED SYSTEM,
Alaska Univ., Fairbanks. Inst. of Marine Science.
H. J. Niebauer.
Estuarine and Coastal Marine Science, Vol 10, No 5, p 507-521, May, 1980. 12 Fig, 26 Ref.

Descriptors: *Model studies, *Numerical analysis, *Fjords, *Subarctic zone, *Water circulation, Mathematical models, Estuaries, Continental shelf, Coriolis force, Water currents, Wind-driven currents, Advection, Alaska.

A cross-sectional numerical model of continental shelf-silled fjord coupled systems was constructed to simulate bottom water renewal processes in silled estuaries. The finite difference, time dependent model is non-linear and includes friction, stratification and topography while assuming no longshore propagation or advection. The model was applied to a high altitude subarctic fjord opening on to the Gulf of Alaska shelf. Modeling experiments on Resurrection Bay suggest that the Coriolis force should be taken into account in studying the bottom water renewal of narrow fjord basins. Coastal upwelling and downwelling on the adjacent shelf greatly affect fjord wide circulation and renewal. These findings suggest that deep-water renewal is almost continuous year round although the driving forces and associated results are strongly seasonal. The model results showed good agreement with hydrographic, meteorological and current data from the Resurrection Bay-continental shelf system.
W84-00298

GROUNDWATER-SOLUTE INFLUX,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
D. R. Lee.
Limnology and Oceanography, Vol 25, No 1, p 183-185, January, 1980. 1 Fig, 19 Ref.

Descriptors: *Solute transport, *Groundwater, Marshes, Salt marshes, Great Sippewissett Marsh, Nutrients, Fluctuations.

Questions are raised concerning a previously published paper (Valiela, I., et al., Nutrient and particulate fluxes in a salt marsh ecosystem: tidal exchanges and inputs by precipitation and groundwater, Limnology and Oceanography, Vol. 23, p 798-812, 1978). According to the present discussion, it seems justifiable to conclude that groundwater may be an important source of nutrients to salt water, but the hydrogeologic features of the specific study area must be given due attention. For example, samples from springs may not be adequate for estimating the quality of groundwater entering a body of surface water. Dramatic variations in discharge from a regional groundwater flow system seem questionable. Estimated groundwater input to Great Sippewissett Marsh may differ from an estimate based on the Darcy equation. In the current study an independent estimate of probable groundwater flow to the marsh was made based on available hydrogeologic information and gave a much lower value, 1,500 cu m per tidal cycle, compared to the estimate of Valiela et al., 6,700 cu m per tidal cycle. Additional estimates of nitrogen loading of groundwaters were also made, and gave far lower nitrogen and salinity values than those in the original paper. (Baker-FRC)
W84-00303

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

FINAL REPORT ON THE TESTING OF THE ABSORPTION FREEZING VAPOR COMPRESSION PILOT PLANT AT THE WRIGHTSVILLE BEACH TEST FACILITY,
North Carolina State Univ. at Raleigh. Water Process Development Lab.
L. Fleming.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110741, Price codes: A06 in paper copy, A01 in microfiche. Final Report, September 30, 1982. 110 p, 15 Fig, 3 Tab, 5 Append. OWRT C-90227-D(NO 9530)(1), 14-34-0001-9530.

Descriptors: *Desalination apparatus, *Seawater, *Heat transfer, *Absorption freezing vapor compression, Energy consumption, Pilot plants, *Desalination plants, *North Carolina, Wrightsville Beach.

The absorption freezing vapor compression (AFVC) pilot plant is a vacuum freezing process which utilizes a concentrated sodium chloride solution to absorb the large volumes of low pressure water vapor produced in the freezer. This vapor is boiled off in a generator and used to melt the ice formed in the freezer. Seawater does not come in contact with any heat transfer surface nor with the refrigerant and therefore no contaminants are introduced into the aqueous system. Other advantages of the process include: low process temperatures, which reduces corrosion; low theoretical

energy requirements; and no need for pre-filtering of the feed water. The design objective of the plant was to demonstrate a specific energy consumption of 50 kWhr per 1000 gallons of product water at a production rate of 25,000 gpd. The pilot plant was started up in the fall of 1979. Steady state operation of the pilot plant was not achieved until November, 1980, when an auxiliary heat rejection compressor was installed. This compressor provided the capability to reject all the waste heat from the process and thus made steady state operation possible. The normal duration of runs was 100 hours. The plant was not capable of unattended operation. The longest period of uninterrupted steady state operation was approximately 48 hours. The maximum steady state open loop production rate achieved was 21,300 gpd on January 7, 1982. The specific energy consumption was 104 kWhr per 1000 gallons of product water for this run. The high rate of energy consumption was due largely to the poor performance of the absorber and generator heat exchangers and the higher than expected heat rejection load. (Moore-SRC)
W84-00001

MECHANISM AND MOLECULAR INTERACTIONS IN THE TRANSPORT OF WATER THROUGH MEMBRANES,
Agricultural Research Service, Albany, CA. Western Regional Research Center
J. R. Scherer, D. P. Malladi, G. F. Bailey, and S. Kint.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110832, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, (1983). 81 p, 42 Fig, 2 Tab, 30 Ref. OWRT C-90297-S(No 9445)(1), 14-34-0001-0445.

Descriptors: *Cellulose acetate membranes, *Pore water, Absorption, Reverse osmosis, Polymers, Hydration, Polyimide membranes, *Desalination, Desalination processes, *Membrane processes.

Changes in waveguide properties of several cellulose acetate membranes and one polyimide membrane were measured as a function of their exposure to varying levels of relative humidity. The volume fraction of water in the films and the occupied pore volumes were determined from refractive index and thickness changes. The dependence of the refractive index on water absorption is related to a competition between two processes: 'pore filling' with no film expansion and 'free expansion' where the film expands to accommodate the added water volume. The hydration properties of these membranes are affected by degree of acetylation, casting temperatures and annealing treatments. Annealing CA398 membranes at 180 degrees C decreases film water concentration by reducing 'free expansion'. Annealed CA398 membranes that were tested in a reverse osmosis cell had high salt rejection compared to unannealed films. The hydration characteristics of a polyimide membrane are compared to cellulose acetate membranes. Raman measurements of unannealed CA and CTA membranes and annealed CA membranes using the waveguide technique showed that OH groups in unannealed polymers are all hydrogen bonded and are highly accessible to absorbed water. The intergrated OH stretching intensity in the region of 3050 to 3800 cm super -1 was found to be linearly dependent on water concentration. Water absorbed in the 'pore filling' stage is weakly hydrogen bonded to C=0 groups in the polymer and water absorbed in the 'free expansion' stage is hydrogen bonded like bulk water at equivalent 90 degrees C. Analysis of the C=0 stretching region indicated that each of the OH groups of a water molecule are H-bonded to a different C=0 group of the polymer in the 'pore filling' stage of absorption.
W84-00010

SECOND TUBINGEN SYMPOSIUM ON SYNTHETIC MEMBRANES IN SCIENCE AND INDUSTRY,
E. Bayer, and H. Strathmann.
In: Desalination, Vol 34, Nos 1/2, p 1-158, July-August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 75 Fig, 24 Tab, 121 Ref.

Descriptors: *Membrane processes, *Membranes, *Desalination, *Desalination apparatus, Desalination plants, Solute transport, *Synthetic membranes.

The main goal of the Symposium was to initiate a dialogue between membranes experts and possible users of synthetic membranes who were not interested in specific problems of membrane preparation techniques or transport phenomena but would like to find out how membranes can be utilized to solve problems in their specific area of interest. The symposium, which was organized by the Department of Organic Chemistry of the University of Tubingen, hosted more than 250 participants from 15 countries. The basis of synthetic membranes and their applications were described in 6 review lectures. In another 40 papers, the various aspects of synthetic membranes were discussed with the main emphasis concentrated on their practical use. With the rapid growth of industrial applications of membranes and membrane processes, a transition took place in the scientific community interested in synthetic membranes. In the early days of membrane research, mainly physical chemists were interested in this field. Today, scientists and engineers from various scientific disciplines are involved in the field of synthetic membranes. Polymer and organic chemists are mainly concerned with preparation of membranes with desired transport properties, physical chemists study these transport properties and develop new methods for their practical utilization, chemical engineers convert laboratory scale operations into efficient industrial processes.
W84-00052

SELECTION OF MICROPOROUS MEMBRANES FOR OPTIMUM SEPARATIONS,
Nuclepore Corp., Pleasanton, CA.
H. W. Ballew, and M. C. Porter.
In: Desalination, Vol 34, Nos 1/2, p 3-10, July - August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 5 Ref.

Descriptors: Separation techniques, Water purification, *Membranes, *Membrane processes, Desalination, *Microfiltration, *Microporous membranes.

There are basically only two types of microporous membranes commercially available; the screen type and the depth type. Each has numerous advantages and disadvantages. The user should carefully consider several characteristics in selecting which of the two types will perform the optimum separation. This paper compares the physical structure, chemical resistance, retention and other performance characteristics of the two types of membranes and summarizes how these differing characteristics may be utilized to maximum advantage in a variety of typical laboratory and industrial microfiltration applications.
W84-00053

LABORATORY EXPERIMENTS WITH HYPERFILTRATION MEMBRANES,
Heidelberg Univ. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
W. Schneider, and O. Bauer.
In: Desalination, Vol 34, Nos 1/2, p 11-24, July - August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979) 4 Fig, 2 Tab, 6 Ref.

Descriptors: Separation techniques, Water purification, *Membranes, *Membrane processes, Model studies, Desalination, *Hyperfiltration membranes, Reverse osmosis.

The operation properties of hyperfiltration membranes are representable by various model concepts. The different mathematical relationships that are based on the respective models correspond to the known phenomenological ones and are suitable for describing the throughput through these membranes as well as their separation behaviour within a wide range of operation. Since those relationships are of the same analytical type, it is difficult to account for the mode of action of the membrane from these equations. Laboratory tests with RO membranes are reported with the aim of discussing experimental results which are not covered by the mathematical relationships or which deviate from them respectively. An analysis of these results seems to be helpful for extending the knowledge of the hyperfiltration process.
W84-00054

TREATMENT BY REVERSE OSMOSIS OF CERTAIN SOLUTIONS CONTAINING TWO SOLUTES, ONE ORGANIC AND ONE INORGANIC,
New South Wales Univ., Kensington (Australia). School of Chemical Engineering.
M. J. Clinton, and R. T. Fowler.
In: Desalination, Vol 34, Nos 1/2, p 25-34, July-August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979) 3 Fig, 1 Tab, 22 Ref.

Descriptors: Water treatment, Aqueous solutions, Solvation, Membranes, *Membrane processes, *Reverse osmosis, *Solutes, Sodium nitrate, Sodium sulphate, Urea, Glucose, *Solute transport, Desalination, *Electrolyte transport.

Experiments were performed to see whether equations developed to describe the reverse osmosis treatment of single-solute solutions would be applicable when the solutions to be treated contained both an ionic and a non-ionic solute. Four solutes were chosen: sodium nitrate, sodium sulphate, urea and glucose. Corrections to the traditional equations for electrolyte transport through the membrane were found to be necessary. For some of the two-solute solutions, a certain amount of solute-solute coupling was detected but its influence was small.
W84-00055

LOW TEMPERATURES AND DISSOLVED GASES: TWO PROBLEMS IN SUBMARINE SEA WATER DESALINATION,
Technische Univ., Munich (Germany, F.R.). Dept. of Chemical Engineering.
M. Hampe.
In: Desalination, Vol 34, Nos 1/2, p 35-56, July-August 1980 (comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979) 17 Fig, 4 Tab, 6 Ref.

Descriptors: *Membranes, *Membrane processes, Reverse osmosis, Ions, *Desalination, Seawater, Desalination processes, *Submarine desalination, Ionic rejections, Volume fluxes, Gas permeability.

The behavior of four types of reverse osmosis membranes for sea water desalination at temperatures between 0 degrees C and 20 degrees C was investigated. Besides the rejections of the ionic chief constituents of the sea water and the volume fluxes through the membrane, the permeabilities of gases dissolved in sea water, namely nitrogen, oxygen, argon and (total) carbon dioxide were determined. The volume fluxes show a not expected independance on pressure at temperatures near 0 degrees C. A possible explanation is given.
W84-00056

MEMBRANE/WATER DISTRIBUTION AND DIFFUSION OF NICKEL ION IN CELLULOSE ACETATE MEMBRANES,
G. Mossa, R. Passino, and M. Pegoraro.
In: Desalination, Vol 34, Nos 1/2, p 57-68, July-August 1980 (comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 5 Fig, 1 Tab, 12 Ref.

Descriptors: Separation techniques, Aqueous solutions, Membranes, Membrane processes, *Reverse

osmosis, *Cellulose acetate membranes, *Nickel ion, *Ion transport, Ions, Desalination.

In the framework of a study on the removal of metals from aqueous solutions by reverse osmosis, Ni super ++ diffusion and distribution between weakly charged cellulose acetate (CA) dense membranes and aqueous NiSO sub 4 were determined. NiSO sub 4 solutions with concentrations from 0.1 to 0.001 were used. The values of diffusion coefficients were found to be 10 to the minus 13 squ cm/s and practically independent of salt concentration. Distribution coefficient data varied as a function of the external solution concentration, according to Anderson's treatment of electrolyte sorption. The experimental data were in satisfactory agreement with Glueckauf's physical model of distribution, at sufficient high concentrations.
W84-00057

SOLVENT RESISTANT MEMBRANES FROM POLY-(P-PHENYLENE-TEREPHTHALAMIDE),
Forschungsinstitut Berghof G.m.b.H., Tuebingen (Germany, F.R.).
P. Zschocke, and H. Strathmann.
In: Desalination, Vol 34, Nos 1/2, p 69-76, July-August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 2 Fig, 4 Tab, 5 Ref.

Descriptors: Separation techniques, *Membranes, *Membrane processes, Polymers, Desalination, *Ultrafiltration membranes, Poly(p-phenylene-terephthalamide polymer.

A new solvent resistant ultrafiltration membrane has been developed from poly-(p-phenylene-terephthalamide), a polymer available from du Pont. This membrane exhibits a water flux of 4,500 1/m super 2 d with a rejection of cytochrome C in excess of 99% at 5 bars. Fluxes from 1,450 to 13,800 1/m super 2 d are observed for common solvents. The membrane is stable in almost all organic solvents including dimethylsulfoxide, n-methylpyrrolidone, dimethylacetamide and others.
W84-00058

PROPERTIES AND LONG-TERM BEHAVIOR OF ION EXCHANGE MEMBRANES,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie.
K. Kneifel, and K. Hattenbach.
In: Desalination, Vol 34, Nos 1/2, p 77-96, July-August 1980 (comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Membranes, *Membrane processes, *Electrodialysis, Water treatment, Wastes, Desalination, Electrolysis plants, *Ion exchange membranes.

Membrane data available in the literature from data sheets of the membrane manufacturers are difficult to compare due to different and at times ill-defined test conditions. The characteristic properties: permselectivity, electrical resistance, ion exchange capacity, and water content of commercial ion exchange membranes were therefore determined under standardized conditions. To obtain information about the useful lifetime and the range of applicability in electrodialysis plants, the membranes were subjected to several chemical environments both at room temperature and at elevated temperatures for periods up to five years. The results obtained should be helpful in selecting the appropriate membranes for different electrodialysis applications such as water desalting, wastewater treatment, and recycling of chemical process solutions.
W84-00059

MORPHOLOGY OF AROMATIC POLYAMIDE TYPE ASYMMETRIC REVERSE OSMOSIS MEMBRANES,
Academia Sinica, Dalian (China). Dalian Inst. of Chemical Physics.
Chen Jiayan, Bi Shuchun, Zhang Xingda, and Zheng Lingying.
In: Desalination, Vol 34, Nos 1/2, p 97-112, July-August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 19-19, 1979). 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Membranes, *Reverse osmosis, Desalination, *Membrane processes, Membrane morphology, Scanning electron microscope, Transmission electron microscope, Asymmetric membranes, *Aromatic membranes.

The morphology of aromatic polyamide type reverse osmosis membranes has been investigated with the aid of the scanning and transmission electron microscopes (SEM and TEM). The majority of the samples are treated by the method of critical point drying (CPD) and then observed with a SEM. It has been found that in the dense layer of these asymmetric membranes prepared with significant solvent evaporation, there exists a micellar structure, but various types of defects have been observed on the surface of some parts of such membranes. The variation in structure in the cross-section off these membranes due to different membrane materials and preparation techniques was observed. In the membranes we studied, we found the RO performance to be correlated not only with the degree of densification and reliability of the surface layer but also with the structure of the cross-sections. The cross-section structure characteristics of such membranes with higher RO performance are rather different from those reported in the literature on cellulose acetate and Nomex membranes without notable evaporation. The influence of the casting conditions of the membranes on the morphology is discussed preliminarily.
W84-00060

USE OF THIN CHANNEL SYSTEMS FOR ULTRAFILTRATION AND HYPERFILTRATION,
W. Kofod Nielsen, and R. Frik Madsen.
In: Desalination, Vol 34, Nos 1/2, p 113-130, July - August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 13 Fig, 6 Ref.

Descriptors: *Membranes, *Membrane processes, Desalination, *Ultrafiltration membranes, *Hyperfiltration membranes, Polarization, Thin-channel systems.

One of the first systems developed for hyperfiltration in the 1960's was a thin-channel system. In the 1970's, a thin-channel system was developed with short channels which proved to be excellent for hyperfiltration as well as for ultrafiltration. A description of the system is given. Examples of the applications of thin-channel systems for concentration at high viscosities and high dry-substance contents, e.g. in the food industries, are given. The theory of thin-channel systems is briefly described, especially in respect to answering to question why thin-channel systems are especially suited for treatment of highly viscous liquids. Concentration polarization is an important factor in determining capacity and membrane-separation properties. The concentration polarization can be calculated theoretically, but is difficult to measure quantitatively. A description of a thin-channel system is given, in which the membrane surface can be seen visually. In such a system, the concentration polarization can be shown visually, using coloured solutions. In this way, the influence of flow and pressure on the concentration polarization can be shown by photographs of the concentration-polarization profiles. A survey of the thin-channel systems on the market today is given.
W84-00061

ULTRAFILTRATION PROCESSES FOR POLLUTION CONTROL AND CHEMICAL REUSE IN THE TANNING INDUSTRY,
Naples Univ. (Italy). Facolta di Ingegneria.
E. Drioli, and B. Cortese.
In: Desalination, Vol 34, Nos 1/2, p 131-140, July - August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 3 Fig, 5 Tab, 3 Ref.

Descriptors: Separation techniques, Water treatment, Emulsions, Membranes, *Membrane processes, Water purification, Waste disposal, Desalination, Industrial wastes, *Ultrafiltration membranes, Streams recycle, *Tanning industry wastes.

The new regulations which are in force today require that tanning plants study and implement new technique to reduce pollution at costs which are not prohibitive to the economic continuation of the basic tanning process. In this paper, are presented results obtained in ultrafiltration experiments upon two of the most polluting process streams which leave the tannery: the dehairing and the decreasing waste. These results clearly indicate the possibility of solving large part of the pollution problems with ultrafiltration processes and streams recycle.
W84-00062

THE INFLUENCE OF THE POROUS SUBLAYER ON THE SALT REJECTION AND REFLECTION COEFFICIENT OF ASYMMETRIC CA MEMBRANES,
Technical Univ. of Denmark, Lyngby. Inst. for Kemindustri.
G. Jonsson.
In: Desalination, Vol 34, Nos 1/2, p 141-158, July - August, 1980 (Comprising papers on desalination of the Proceedings of the Second Symposium on Synthetic Membranes in Science and Industry, Tubingen, September 17-19, 1979). 10 Fig, 3 Tab, 23 Ref.

Descriptors: *Membranes, *Membrane processes, Reverse osmosis, Desalination, *Cellulose acetate membranes, Salt rejection, Reflection coefficient.

A relation between the reflection coefficient of the membrane skin, sigma sub alpha, and the overall reflection coefficient for an asymmetric membrane, sigma, has been derived. It is shown that the solute permeability for the skin layer, omega sub alpha, and for the porous sublayer, omega sub b, can be estimated from two sets of reverse osmosis experiments. The ratio omega sub alpha to omega sub b varies greatly with the selectivity of the membrane giving a non-linear relation between omega and omega sub alpha. However, the limiting retention, R super (max) and omega sub alpha seem to be fairly equal independent of the pressure level, thus confirming the theoretically derived relation R super (max)= omega sub alpha.
W84-00063

HYDRODYNAMICS AND HEAT EXCHANGE DURING FILM EVAPORATION OF SEA WATER IN A VAPOUR-WATER UPFLOW,
Dalnevostochnyi Politekhnicheskii Inst., Vladivostok (USSR).
V. Slesarenko.
Desalination, Vol 33, No 3, p 251-258, June, 1980. 4 Fig, 4 Ref.

Descriptors: Desalination, *Desalination processes, *Distillation, Hydrodynamics, *Heat exchange, Seawater, Film evaporation, Vapor-water upflow.

On the basis of experimental research some features of heat exchange during sea water boiling under two-factor system of intensification of the process obtained by means of inclination of the heating surface and application of external vibrating and disturbing actions have been established. Experiments showed that under the above conditions the heat transfer coefficient is 25 - 30% higher than that of a horizontal surface. Some equations have been obtained and experimental data have been summarized.
W84-00064

RAYLEIGH-JEFFREYS STABILITY OF THERMOHALINE STRATIFIED FLUIDS SUBJECT TO HORIZONTAL FLOWS,

Technion - Israel Inst. of Tech., Haifa. Energy Lab.
D. Pneuli, and Y. Zvirin.
Desalination, Vol 33, No 2, p 163-184, May, 1980. 2 Fig, 35 Ref.

Descriptors: Desalination, *Desalination processes, Solar ponds, Horizontal flow, *Rayleigh-Jeffreys stability, *Stratified fluids.

The stability of a horizontal layer of a fluid with density stratification due to both temperature and solute gradients, subject to horizontal flow, is studied for different sets of homogeneous boundary conditions. Sufficient conditions for stability, i.e., the maintenance of the original stratification are obtained as the relation between the thermal Rayleigh number, RaT, and the solute Rayleigh number, RaS. A sufficient condition for stability is obtained for all sets of boundary conditions, where PrT and PrS are the thermal and the solute Prandtl numbers, respectively. This condition is, therefore, also applicable in cases where the physical boundary conditions are not well defined, e.g., in practical engineering use of solar ponds.
W84-00065

ELECTRODIALYSIS IN THE REGENERATION OF PAPER MILL SPENT LIQUOR,
Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W84-00066

SOLAR OPERATED, MULTIFLASH DISTILLATION,
Scientific Research Foundation, Jerusalem (Israel).
H. Z. Tabor.
Desalination, Vol 33, No 2, p 221-224, May, 1980. 1 Fig, 4 Ref.

Descriptors: Desalination, *Desalination processes, *Distillation, *Solar operated flash distillation, Multi-stage flash distillation.

The proposal by Gasparini et al of desalination units coupled to solar collectors is criticized. The author shows that the paper contains a number of errors which invalidate its conclusions. There is an apparent confusion of average efficiencies, of mean solar radiation for a heliostatically mounted collector with that for a stationary collector. Also the economic calculations are of little value.
W84-00067

COMMENT ON 'SIGNIFICANT DEVELOPMENTS IN MEMBRANE DESALINATION - 1979',
Yorkshire Imperial Metals Ltd., Leeds (England). Research and Development Dept.
K. Hill.
Desalination, Vol 33, No 2, p 225, May, 1980.

Descriptors: Desalination, *Desalination processes, *Reverse osmosis, Seawater, Membranes, *Membrane processes.

In this letter to the Editor, the paper by M. Mattson (Desalination 28(1979)207-224) is lacking comment on the high dissolved solids contents cited with regard to the product water from reverse osmosis treatment of seawater.
W84-00068

TRANSIENT KINETICS OF PROCESSES AT MEMBRANE/SOLUTION INTERFACES,
California Univ., Berkeley. Water Thermal and Chemical Technology Center.
C. C. Herrmann, J. Sinkovic, and T. Vermeulen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113620, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, June 1983. 72 p, 28 Fig, 24 Ref, 3 Append. OWRT C-90015-S(9409)(1), 14-34-0001-9409.

Descriptors: *Electrodialysis, *Electrical impedance, *Fouling, *Membrane, *Polarization, Cleaning, *Desalination, Hyperfiltration, Reverse osmosis.

Electrical impedances of anion-exchange and cation-exchange membranes have been measured in sodium chloride electrolytes under conditions appropriate to desalination by electrodailysis. Alternating-current and Laplace-transformed-pulse methods were used. Results are reported for several membranes under normal desalting current densities, and at high densities causing acid-base formation, with and without presence of a fouling layer. Impedance maxima were found at limiting currents. Under conditions causing substantial concentration-polarization at the membrane diluate interface, a large difference in impedance with measurement frequency was found. Fouling increased low-frequency (diffusion) impedance more than high frequency (resistive) impedance. Measured at 100 Hz, the impedance across an anion-exchange membrane increased substantially at current densities sufficient to cause serious concentration polarization. Measured at 10 KHz very little increase was found. As with the anion-exchange membrane, the impedance at 100 Hz across a cation-exchange membrane increased substantially at current densities sufficient to cause concentration-polarization. However, in contrast with the anion-exchange membrane, the impedance at 10 kHz increased also. The increase of impedance on fouling (with ferric hydroxide) of the cation-exchange membrane was greater.
W84-00160

RESEARCH ON FEASIBILITY OF THIN-FILM COMPOSITE MEMBRANES IN PLATE AND FRAME DEVICES FOR REVERSE OSMOSIS,
FilmTec Corp., Minneapolis, MN.
R. J. Petersen, R. H. Forester, and C. F. Thompson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113703, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, August 1983. 63 p, 15 Fig, 4 Tab, 9 Ref, 1 Append. OWRT C-00196-D(1), 14-34-0001-1407.

Descriptors: *Reverse osmosis, *Economic feasibility, Water treatment, Membrane fouling, *Composite membranes, Plate and frame device, Mississippi River, Minnesota.

The technical and economic feasibility of using plate and frame reverse osmosis systems for low pressure brackish water conversion in conjunction with thin-film composite membranes was investigated. Comparisons were made of membrane fouling rates on Mississippi River water using both FT-30 spiral wound membrane elements and a commercial plate and frame device loaded with FilmTec FT-30 membranes. Both membrane systems exhibited rapid fouling rates at recovery ratios of 50% and higher when run on sand-filtered, pH-adjusted river water. Both membrane systems exhibited approximately the same rates of membrane flux decline due to fouling when examined at comparable recovery rates. The plate and frame system, however, could be restored to its initial flux levels by cleaning treatments, while this was not true for the spiral would elements. For feedwater sources not containing colloidal suspended solids, plate and frame systems were concluded to be economically not feasible based on current cost data. If, however, the feedwater source contained colloidal suspended solids and was known to foul reverse osmosis membranes, certain scenarios favored large plate and frame systems.
W84-00168

PROCEEDINGS OF THE INTERNATIONAL CONGRESS ON DESALINATION AND WATER REUSE, MANAMA, BAHRAIN, NOV. 29-DEC. 3, 1981.
Fairleigh Dickinson Univ., Teaneck, NJ.
Desalination, Vol 38, Nos 1/2/3, November 1981, p 1-588, M. Balaban, R. Bakish, editors.

Descriptors: *Desalination, Desalination plants, *Distillation, Reverse osmosis, Electrodialysis, Solar distillation, Pretreatment of water, Scaling, Materials engineering.

First volume of these Proceedings of the international congress on desalination with the participation of scientists and engineers in the field. This volume contains 58 papers on Thermal Processes, Scale Control, Materials, Membranes - Reverse Osmosis (Fundamentals, Pretreatment, Seawater RO), Membranes - Electrodialysis. (Volume 39 of Desalination constitutes the second volume of the Proceedings).
W84-00203

VAPOR COMPRESSION DISTILLATION WITH MAXIMUM USE OF WASTE HEAT,
Ebasco Services, Inc., New York.
S. J. Senatore.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 3-12, 3 Fig, 6 Ref. (1st Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination process, *Distillation, Vapour compression distillation, Waste heat.

The vapor compression distillation process can be designed as a low capital cost and corresponding low performance ratio (about 7 lbs product per KBtu) or as a higher capital cost and higher PR (about 31) plant. The low PR plant is designed with a maximum brine temperature of about 130F requiring only a polyelectrolyte scale inhibitor. This design would employ a centrifugal compressor that has a pressure ratio of about 1.2. The high PR plant design, which is the subject of this paper, operates at maximum brine temperature of 250F and uses a higher pressure ratio of 1.58. Use of waste heat will be stressed. Either the high or low PR VC process is extremely versatile in application, since it is well adapted to either a dual purpose (power and water) or a single purpose (water only) plant. The high PR that is easily attainable in this design is becoming increasingly more attractive, from an economic view, as the price of fuel continues to escalate. For example, at $5.00/MBTU the fuel contribution to the total cost of water is $5.20/Kgal at a PR of 8 and is reduced to about $1.34/Kgal at a PR of 31. The design and process descriptions for a 2.35 mgd plant will be presented. This plant employs a 65,000 CFM centrifugal compressor. The compressor is driven by a diesel engine and operates across a 4 effect vertical tube foam evaporator. An updated plant cost estimate will be presented and cost of product water.
W84-00204

AN ADVANCED BARGE MOUNTED VTE/VC FOR THE DESALINATION OF SEAWATER,
Envirogenics Systems Co., El Monte, CA.
D. K. Emmermann.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 13-20, 4 Fig, 2 Ref. (1st Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3 1981).

Descriptors: *Desalination, *Distillation, Seawater, Vertical tube evaporator, Vapour compression distillation.

An advanced VTE/VC seawater desalination plant is described. It is a barge-mounted, selfcontained demonstration plant with a rated freshwater output of 5,000/cu m per day and a performance ratio of 30:1 which includes the plant's electrical consumption. Included is a process description of a 24 effect VTE unit with a steam turbine driven compressor and generator combined with two topping effects. Additional features incorporated on the barge include foamy upflow evaporation, ion exchange for seawater pretreatment as well as provision for acid or polymer dosing, and the capability of operation up to a maximum brine temperature of 150C. Test and operational data are presented.
W84-00205

INDUSTRIAL OPERATING EXPERIENCE OF MORE THAN THREE YEARS WITH A 1440 M SUPER 3/DAY SNAMPROGETTI VTE,
Snam Progetti S.p.A., Milan (Italy).
P. Tiraboschi.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 21-28, 4 Fig, 2 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination processes, Multistage flash distillation, *Acids, *Pretreatment of water.

The new desalination process developed by Snamprogetti is discussed and the experiences gained in over 3 years of industrial run is discussed. For two and a half years the plant was fed with acid treated sea water, while in October 1980 it was decided that a high temperature inhibitor, namely Nalco D-4221, should be used. This modification had been envisaged since the beginning as a possibility which, within the programme of research on the desalination unit, could provide an alternative to the acid treatment. The results achieved in over 6 months of this new treatment are good, despite a slight reduction in the thermal exchange coefficients as compared with the results of the acid treatment. An examination of the production diagram shows the good reliability and consequent on stream factor of 94%, which is considerably higher if compared with the 70% of an average MSF plants.
W84-00206

PROCESS SELECTION GUIDE TO SEAWATER DESALTING,
Aqua-Chem, Inc., Milwaukee, WI.
D. R. Finnegan, and W. M. Wagner.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 29-48, 9 Tab, 5 Ref, 6 Fig. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3,1981).

Descriptors: *Desalination, Desalination plants, Distillation, Reverse osmosis.

As desalting technology advances, old processes change and new ones are developed. The current commercial seawater desalting processes including mechanical vapor compression (MVC), thermocompression (TC), multiple effect (ME), once-through multistage flash (MSF-OT), brine recirculation multistage flash (MSF-BR), and reverse osmosis (RO) are compared. These processes are compared on the basis of maintenance and operating complexicity and capital and operating costs. The goal of the paper is to help users and planners answer the question, 'What process is best for me.' Although some of the comments are applicable to all size plants, they are directed primarily to plants less than 2,000,000 GPD capacity. Plants using a combination of processes or hybrid systems are not considered.
W84-00207

COMPARISON OF MSF HEAT REJECTION SECTIONS AND SEAWATER COOLED POWER STATION CONDENSERS,
Watson Desalination Consultants, Manassas, VA.
B. M. Watson, and K. Eimer.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 49-56, 2 Fig., 20 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination processes, Distillation, Multistage flash distillation, *Evaporators, *Condensers, Cooled power station condenser.

A comparison of seawater cooled power station condensers and the heat rejection sections of multistage flash evaporators (MSF) showed very similar design and operational parameters. Remarkable differences are to be seen with regard to the design fouling factor. Typical design fouling factors of MSF rejection sections are about 7 times higher than with a power station condenser. This will result in a heat exchange surface of the rejection section, which is about 50% to 70% larger than with P.S. consensers and will subsequently cause higher capital costs. Design fouling factors much lower than the ones used up to now are recommended.
W84-00208

ADVANTAGES OF THE EJECTOCOMPRESSION PROCESS IN SEA WATER DESALINATION,
Societe Internationale de Dessalement, Paris (France).
M. Lucas, and S. Hessemans.
In: (1st. Volume of the Proc. ofthe Intern. Congress on Desalination and Water Reuse, Bahrain, Nov 29-Dec 3, 1981) Desalination, Vol 38, Nos 1/2/3, November 1981, p 57-63, 2 Fig, 2 Tab.

Descriptors: *Desalination, Desalination process, *Distillation, Multistage flash distillation, Ejecto-compression.

The various techniques were developed by SIDEM for seawater desalination. Among those techniques the vapour compression process by ejectocompression is discussed. The ejecto-compression process has allowed SIDEM to construct packaged type units with rising maximum capacities: 600 cu m/d in 1979, 1,500 cu m/d in 1980, 2,600 cu m/d in 1981. The main characteristics of 1,500 and 2,600 cu m/d units are given and their operating experience of this type of plants are reviewed. Multiflash units of same capacity are compared in terms of investment costs as well as compactness reliability.
W84-00209

THE EFFECT OF AIR ON CONDENSATION ON A ROPED TUBE,
Glasgow Univ. (Scotland).
J. Cunningham, and A. Holmes.
In: Desalination, Vol 38, nos 1/2/3, November 1981, p 65-74, 5 Fig, 2 Tab, 6 Ref. (1st. Vol of Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, *Heat transfer surfaces, Roped tubes, Plain tubes, *Tubes.

With an increasing interest in the use of enhanced heat transfer surfaces being shown in connection with desalination, experiments have been carried out to compare the effect on different tubes of noncondensable gases. The tests were made on two roped and one plain tube, each tube having a nominal length and inside diameter of 690 mm and 11 mm respectively. Cooling water velocities ranged from 0.8 m/s to 4.2 m/s and bulk air concentrations at inlet of up to 4.25% by weight were investigated. Although the effect of air on the condensation process was greater on the roped tubes at low cooling water velocities, at the velocities commonly associated with desalination plants there was little difference between the effect of noncondensables on roped and plain tubes. This type of fouling is no worse on roped tubes compared to plain tubes.
W84-00210

DESALINATION BY VAPOR COMPRESSION,
Maschinenfabrik Augsburg-Nuernberg A.G., Munich (Germany, F.R.). Abt. Neue Technologie.
W. Bulang.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, 10 Figs. p 85-97 (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, Vapor compression distillation.

Description of a newly developed desalination plant system is given. The advantages of the new system are mainly: low operating costs, simplicity of the monostage integrated design, and moderate operation temperatures resulting in negligible corrosion and scaling. A high speed high efficient vapor compressor with high volumetric flow is integrated to the vaporator tank. Horizontal heat exchanger bundles with high heat transfer coefficient self-cleaning low erosion film flow are suspended in a cylindrical evaporator tank. Results of operation under various process parameters are presented.
W84-00211

THE EFFICIENT PRODUCTION OF ELECTRICITY AND WATER IN COGENERATION SYSTEMS,
Bechtel Power Corp., San Francisco, CA.
S. K. Tadros.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, 3 Figs, 1 Tab, 6 Ref. p 99-108 (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Distillation, Electric power, Multistage flash, Steam turbine, Cogeneration systems, Power to water ratio.

Two topping cycle steam turbine cogeneration systems are discussed that can be used to simultaneously produce electricity and water. The water desalination plant selected for detailed comparison is the well-known multistage flash (MSF) evaporator cycle which uses brine recirculation and high temperature additives for scale protection at 233F maximum brine temperature. The impact is discussed of expected future fuel prices on the design of the cogeneration systems under consideration and factors which would further improve the thermal efficiency of both power and desalination plants. The fuel chargeable to power (FCP) is determined in two cases: Backpressure turbine/multistage flash scheme and Extraction turbine/multistage flash scheme. The relation between the cogeneration index in kWh per million Btu to the process, steam turbine backpressure, and power to water ratio are discussed.
W84-00212

CENTRIFUGAL PUMPS FOR DESALINATION,
Ingersoll-Rand Co., Phillipsburg, NJ.
F. F. Antunes, R. E. Cornman, and R. J. Hartkopf.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, 4 Figs., 7 Ref. p 109-122 (1st. Vol of the Proc. of the Intern. Congress on Desalination and Wate Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination apparatus, Centrifugal pumps, *Pumps, Brines.

Centrifugal pumps used for desalination require more stringent material selections and different design considerations than normal applications. The liquid being pumped can be seawater, brackish water, or a concentrated brine. The longevity of the pumps in service depend on their design and the materials used as well as the operating conditions present. Four different pumps related to desalination are discussed. These include vertical wet pit intake pumps, reverse osmosis horizontal multistage charge (injection) pumps, vertical can brine recycle pumps, and horizontal pipeline transfer pumps.
W84-00213

REVERSE RUNNING CENTRIFUGAL PUMPS AS HYDRAULIC POWER RECOVERY TURBINES FOR SEAWATER REVERSE OSMOSIS SYSTEMS,
W. A. Raja, and R. W. Piazza.
In: (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981) Desalination, Vol 38, Nos 1/2/3, November, 1981. 8 Figs. p 123-134.

Descriptors: *Desalination, Desalination apparatus, Pumps, Seawater, *Reverse osmosis, Hydraulic power, Recovery turbines.

The application is discussed of reverse running centrifugal pumps as power recovery turbines to recover up to 80% of that energy. The economics of Hydraulic Power Recovery Turbine (HPRT) systems are explored with respect to the equipment cost, operating costs and payouts for the different sizes of RO systems. HPRT's come in various sizes, types and configurations with efficiencies being a function of specific design, flow rate, pressure and speed. Typical design features of HPRT's are described for use in RO system. Different schemes and equipment arrangements are available and require the use of steam turbines, motors, electric generators, clutches, and speed controls or a combination of the above for optimum results. Recommendation of the most economical equipment arrangement for the RO system is discussed.
W84-00214

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

DESIGN OF HIGH EFFICIENCY SINGLE AND DUAL PURPOSE PLANTS WITH GAS TURBINES,
G. F. Tusel, and I. Kamal.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 135-144, 8 Figs. (1st. Vol of Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Distillation, Multistage flash, Vertical tube foam evaporation, Reverse osmosis, Gas Turbines, Middle East.

Three basic sizes of gas turbines were considered (30.6, 79.4 and 208 MWe output at ISO conditions). Four different processes were considered for the desalination plants: multistage flash (MSF), vertical tube foam evaporation (VTFE), combined vertical tube foam evaporation-vapor compression (VTFE/VC) and reverse osmosis (RO).
W84-00215

MEDA - A NEW THERMAL CONCEPT FOR DESALTING PLANTS,
G. F. Tusel, B. Ohlemann, D. K. Emmermann, and I. Kamal.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 147 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: Desalination, Desalination plants, *Seawater distillation, VTFE, Vapor compression multistage flash distillation, *Distillation, MEDA project(barge mounted).

The MEDA project comprises a highly efficient, self-contained, VTFE-VC-MSF seawater distillation plant with a capacity of 5000 tons of fresh water per day at a fuel-use performance ratio of 11.8 kg/1000 kJ heat content of fuel. To demonstrate advanced desalting technology with a plant of sufficient capacity in various parts of the world under varying seawater and climatic conditions, MEDA is barge-mounted. Advanced features installed on the barge are: continuous ion exchange pretreatment for removal of calcium and regeneration by brine-blowdown, high heat-transfer rates due to enhanced tubing and foamy up-flow, spirally-indented horizontal tubes in the MSF section, surfactant recovery, turbine driven steam compressor with topping effects, and reverse osmosis system with polishing unit for providing boiler make-up for plant start-up. The calcium removal by ion-exchange permits plant operation with a maximum brine temperature of 150C. Product is redistilled in the MSF cooler to produce high purity distillate for desuperheater injection water and boiler make-up.
W84-00216

PERFORMANCE TESTS ON A VERTICAL TUBE EVAPORATION,
Fachhochschule Cologne (Germany, F.R.).
B. Kunst.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 149 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Vertical tube evaporator, *Distillation, Foaming agents.

A two-effect evaporator with a rated capacity of 10,000 l/d has been designed for measuring heat transfer coefficients, pressure drops, entrainment rates and scaling behavior in upflow and downflow VTE. The evaporator is in a closed loop system. The temperature operating range extends from 45 to 145C. Foaming agent added to the sea-water is continuously recovered from the blow down in an extraction column. The performance of the two VTE effects is measured in dependence of temperature, brine flow, salt and foaming agent content.
W84-00217

IN SITU CORROSION STUDY OF STAINLESS STEELS IN AN MSF DESALTING PLANT,
Uddeholms A.B. Degerfors Jarnverk (Sweden).
S. Nordin.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 151 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Corrosion, Multistage flash distillation, Stainless steel.

The corrosion resistance of different stainless steel grades have been studied as regards localized attack under service conditions. Test racks with welded samples with artifically applied crevices were inserted in three different flash chambers. Materials used for splash plates, brine piping, and condensor tubes were also tested. Being a pilot plant, various process conditions were tested. Hence, the materials have been exposed to different corrosive conditions, including stagnant seawater during shut-down periods. Stainless steels of type 316L and higher alloyed exhibit good corrosion resistance, even in brine at high temperature via pipes from the brine heater.
W84-00218

A TUBELESS EVAPORATOR,
Schroeder Process Corp., Santa Ana, CA.
D. W. Schroeder, and P. J. Schroeder.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 155 (Abstract only)(1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Direct contact evaporation, Tubeless evaporator.

A direct contact evaporation process was developed for desalination and waste concentration which can include by-products recovery. The process uses a working substance (WS), such as a high melting organic compound, at its freezing point, to effect the direct contact evaporation. An acceptable WS must be insoluble in water, inert and easily separated by specific gravity difference from brine, product water, and any solids produced. It is also desirable that they be non toxic, non flammable, cheap, and have a high heat of fusion. Several WS's were identified with potential to be used in a commercial plant. A WS screening program tested melting range, solubility, tendency to entrain or emulsify, and stability, in a laboratory program. The bench-scale-plant program simulated the operation of major pieces of equipment with WSs that passed the screening program, and seawater and other saline waters.
W84-00219

FOAM CONTROL ADDITIVES IN MSF DESALINATION,
Pfizer Central Research, Groton, CT.
M. H. Auerbach, J. J. O'Neill, R. A. Reimer, and S. W. Walinsky.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 159-168, 5 Figs, 2,Tab, 26 Ref.

Descriptors: *Desalination, Desalination plants, *Multistage flash distillation, *Foam control additives, Polyglycol monoalkyl ethers, FLOCON anti-foam AF-4.

Excessive foaming in multistage flash desalination plants can give rise to salt contaminated distillate and reduced operating efficiency. Plant operating variations in pressure, temperature, flow and seawater feed composition and alkalinity can perturb vapor/liquid equilibria, resulting in increased levels of foam. Since such foaming is not always controlled by mechanical means, additives are often needed to control foaming level. In additing to controlling foam, a useful additive must not interfere with heat transfer or with the performance of the scale control additive; it must not contain steam-volatile components that can contaminate the distillate; it must be stable at KSF operating temperatures and residence times; and it should be compatible with the antiscalant feed solution. Antifoam performance data for over 60 candidates in 7 chemical classes were determined according to these criteria. The most effective structural class was found to be the polyglycol monoalkyl ethers. Foam control effectiveness within this class was shown to be a function of ethylene oxide content and alkyl chain length. The most effective additive found is offered commercially as FLOCON Antifoam AF-4. FLOCON AF-4 has been used successfully in high-temperature MSF plants.
W84-00220

CALCIUM SULPHATE SCALE REMOVAL DURING OPERATION IN HORIZONTAL TUBE FILM EVAPORATORS,
Hamon-Sobelco, Brussels (Belgium).
For primary bibliographic entry see Field 8G.
W84-00221

FACTORS AFFECTING THE BRINE SCALING POTENTIAL IN MSF PLANTS,
Albright and Wilson Ltd., Oldbury (England).
For primary bibliographic entry see Field 8G.
W84-00222

TARANTO DESALINATION PLANT: A COMPARISON BETWEEN THEORETICAL AND ACTUAL PH VALUES IN A CORRECT DESIGN ACID TREATMENT PLANT,
Italimpianti S.p.A., Genoa.
S. Arazzini, R. Borsani, G. Migliorini, and P. Bozzini.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 185-199, 6 Fig, 1 Tab, 10 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Distillation, *Hydrogen ion concentration, *Italy, Taranto, Acid treatment plant.

The problem of increasing reliability of acid treatment plants was tackled by ITALIMPIANTI with satisfactory results in 3 steps: (1) Theoretical calculation on pH optimum optimum distribution through the plant, adopting the accepted theory of CO sub 2 hydrolysis and HCO sub 3 equilibria in sea water. Also practical values in the Debye-Huckel equation are used in worked examples. (2) By correct positioning of chemical injection points and pH meters arrangement. (3) By correct sizing of decarbonating tower and degasifier which play a key rule in the success of acid treatment. This philosophy was applied in the 5th desalination plant which ITALIMPIANTI designed, built and put into operation in April 1980 for ITALSIDER at TARANTO Steel Works. Correct design enabled achievement of contract performance guarantees. A brief description of the technical features of the plant, the main parameters and the guide concepts of an easy acid treatment design are reported together with the same operational data collected during last year showing the stability and reliability of the system.
W84-00223

ENERGY CONSUMPTION AND OPERATIONAL ASPECTS OF ON LOAD BALL CLEANING SYSTEMS,
K. Eimer.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 201 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, Evaporators, *Multistage flash distillation, *Load ball cleaning systems.

On load sponge ball cleaning systems have been proved to remove brine side fouling, maintain high heat transfer rates and high performance of MSF evaporators. Besides capital costs, service, and costs for sponge balls, the energy consumption of the system has to be taken into account. Energy consumption is influenced by hydraulic and exergetic losses of the system. Especially the exergetic losses of the system by recirculating the balls with hot or cold water influence the energy consumption considerably. With unfavourable conditions the continuous hot water recirculation from the

brine heater outlet to the coldest recovery stage increases the heat consumption by as much as 5% with a 22,000 cu m /d MSF. Specially designed ball recirculation systems bring this heat loss down to negligible values. Besides the energy consumption the operational aspects of the different ball recirculation systems have been evaluated.
W84-00224

STRUCTURE/PERFORMANCE RELATIONSHIPS OF HIGH-TEMPERATURE MSF SCALE CONTROL ADDITIVES,
Pfizer Central Research, Groton, CT.
S. W. Walinsky, B. J. Morton, and J. J. O'Neill.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 203 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, *Scaling, *Multistage flash distillation, Structure, Performance.

Low molecular weight polymers (MW sub w = 500-10,000) of maleic, fumaric, itaconic, methacrylic, acrylic, and vinylsulfonic acid were prepared and evaluated as high temperature alkaline scale inhibitors. Suppression of valcium carbonate and magnesium hydroxide scale was measured in a laboratory single-stage flash evaporator (120C) and the results compared with the performance of monomeric inhibitors such as amino and hydroxyphosphonates and phosphonocarboxylates. Some critical properties which contribute to scale control were also investigated - including the ability of these additives to inhibit crystal growth, to disperse or suspend alkaline precipitates, and to remain soluble in concentrated seawater over a range of temperatures. The relationship between the alkaline scale control performance of the various additives and their chemical structure, molecular weights and degree of ionization is discussed.
W84-00225

PRESENT TRENDS IN MATERIALS SELECTION AND PERFORMANCE IN MULTISTAGE FLASH DESALINATION UNITS,
Little (Arthur D.), Inc., Cambridge, MA.
J. D. Birkett, and E. H. Newton.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 207-222, 8 Figs, 11 Tab, 9 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Materials testing, Multistage flash distillation.

Data is utilized from a series of worldwide surveys conducted from 1968 to 1980 for the U.S. Department of the Interior, Offices of Saline Water and Water Research and Technology as well as the recent literature to illustrate the improvements made in the materials selection process over the last several years. Trends in materials used for heat exchange tubing, flash chambers and components, pumps, water boxes, etc., are enumerated and evaluated with respect to likely service life as a function of the severity of operating conditions. Plant factor (percent of time operating at rated capacity) is correlated with design and to gain perspective is compared to plant factors achieved in the chemical processing industry generally. Present trade-off decisions with respect to materials, operating temperatures and conditions, performance factors, electrical energy consumption, and use of chemicals are summarized and commented upon.
W84-00226

EROSION-CORROSION RESISTANCE OF COPPER ALLOW C72200 IN SEA WATER CONTAINING SUSPENDED SAND,
Olin Corp., New Haven, CT. Chemicals Div.
For primary bibliographic entry see Field 8G.
W84-00227

CORROSION PROBLEMS CAUSED BY BROMINE FORMATION IN MSF DESALINATION PLANTS,
INCO Europe Ltd., Birmingham (England).
For primary bibliographic entry see Field 8G.
W84-00228

STUDIES OF THE LOCALISED-CORROSION BEHAVIOUR OF SOME STAINLESS STEELS, INCOLOY 825 AND TITANIUM IN SEAWATER,
Glasgow Univ. (Scotland). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 8G.
W84-00229

SEA WATER INTAKE AND ITS EFFECT ON HEAT REJECTION DESIGN AND MATERIAL FOR FLASH DISTILLATION PLANT,
M. H. A. El-Saie, M. S. I. Kafrawi, and A. K. T. A. Karim.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 257-267, 3 Figs, 7 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Seawater, Distillation, *Multistage flash distillation, Jetties, Settling basins, *Suspended solids, Pretreatment of water.

The suspended matter in sea water plays a big role in the design of seawater intake and heat rejection section. The seawater intake usually depends on the shore nature and water quality. Chemical treatment can handle marine growth and bacteria but the suspended matter in the seawater needs further treatment usually by settling basin and screens, these are normally costly and need a minimum plant size to be economical. For relatively small installation of up to about 15 MGPD plant, other solutions can be adopted in the seawater design and the choice of materials for the heat rejection section. For a seawater intake of up to 30,000 or 40,000 cu.m./hour for a desalination plant with a large variation of temperature between summer and winter and suspended mattter in a certain range and sizes of grain, it is more economical to have a jetty with a pressurized rotary screen and titanium tube for the heat rejection section instead of settling basin and copper nickel tubes and seawater recirculation. This will save at least 2% of the total cost of the plant. Also the execution of seawater intake with jetty is much quicker than with a settling basin.
W84-00230

ACID CLEANING AND PASSIVATION OF POWER PLANT CONDENSERS AND DESALINATION PLANTS,
Rome Univ. (Italy). Ist. di Chimica Applicata ed Industriale.
For primary bibliographic entry see Field 8G.
W84-00231

QUALITY CONTROL PROBLEMS IN COPPER ALLOY TUBES MANUFACTURING,
Rome Univ. (Italy). Ist. di Chimica Applicata ed Industriale.
For primary bibliographic entry see Field 8G.
W84-00232

PRE-SERVICE CORROSION CONTROL IN MULTIFLASH DESALINATION PLANTS,
Atel SRL, Rome (Italy).
For primary bibliographic entry see Field 8G.
W84-00233

PRESSURE DROPS ALONG THE BORES OF HOLLOW FIBRE MEMBRANES - THEIR MEASUREMENT, PREDICTION AND EFFECT ON FIBRE BUNDLE, PERFORMANCE,
Glasgow Univ. (Scotland). Dept. of Mechanical Engineering.
W. T. Hanbury, A. Yuceer, M. Tzimopoulos, and C. Byabagambi.
In: Desalination, Vol 38, Nos 1/2/3, p 301-318, 4 Figs, 2 Tab, 4 Ref. (1st. Vol of the Proc of the Intern Congress on Desalination and Water Reuse, Bahrain, Nov 29-Dec 3, 1981).

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, Hollow fibers, B9 fiber bundle performance.

Measurements of the pressure drops along the bores of hollow fibers in a B9 fiber bundle have been made under operating conditions. A theoretical model of the fiber behaviour is presented and analyzed. An analytical solution is obtained for the case of a fiber in a uniform crossflow of brine of uniform concentration and uniform pressure. A numerical procedure, making use of this analytical solution, is developed to solve the more general problem of detailed bundle behaviour. This procedure takes into account the variation of brine concentration along fiber lengths and the fact that in some cases the product concentration can be significant. Sets of experimental data, including the measurements of bore pressures, are presented and analyzed using a computer program based on the numerical procedure presented. Evidence of compression of the fiber bore diameter due to the external brine pressure is found, particularly at higher temperatures and pressures.
W84-00234

A PHYSICOCHEMICAL APPROACH FOR THE CHOICE OF POLYMERIC MEMBRANE MATERIALS FOR WATER DESALINATION BY REVERSE OSMOSIS,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
T. Matsuura, Y. Taketani, and S. Sourirajan.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 319-337, 3 Fig, 7 Tab, 16 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Reverse osmosis transport, Fouling, *Polymeric membranes, Interfacial water layer.

Interfacial properties such as the thickness of interfacial water layer, the distribution coefficient of solute between interfacial and bulk water phases, and the volume of interfacial water per unit mass of polymer material have been identified as relevant physicochemical quantities governing reverse osmosis transport and determined by gas and liquid chromatography methods with respect to different polymeric membrane materials. They are further split into the contribution from the structural component of polymer repeating unit. Force constants A and D for sodium chloride, representing the repulsive force working between membrane surface and solute, have been calculated on the basis of interfacial properties obtained above. Using these forces constants, the pore sizes required to achieve 99.9% of sodium chloride separation are obtained for different polymeric membrane materials. Furthermore, the prediction procedure for the effect of preferentially adsorbed organic molecules on the separation of sodium chloride and product rate is illustrated as a model for 'fouling' in the desalination process by reverse osmosis.
W84-00235

PREDICTING FLUX DECLINE OF REVERSE OSMOSIS MEMBRANES,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
J. C. Schippers, J. H. Hanemaayer, C. A. Smolders, and A. Kostense.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 339-348, 5 Figs, 1 Tab, 4 Ref (1st. Vol of the Proc of the Intern Congress on Desalination and Water Reuse, Bahrain, Nov 29-Dec 3, 1981).

Descriptors: *Desalination, Desalination plants, *Reserve osmosis, Mathematical model, Membrane processes, Ultrafiltration membranes.

A mathematical model predicting flux decline of reverse osmosis membranes due to colloidal fouling has been verified. This mathematical model is based on the theory of cake or gel filtration and the Modified Fouling Index (MFI). Research was conducted using artificial colloidal solutions and a pilot plant equipped with ultrafiltration membranes. Polystyrene latex spheres, having a size of about 0.05-0.08 mu m were used as a foulant. The

measured and calculated values of flux of the ultrafiltration membranes decline as a function of time and agree reasonably well. The difference between the measured and calculated values may be explained by the assumption, that initially blocking filtration occurs instead of cake or gel filtration.
W84-00236

FORMATION OF ASYMMETRIC CELLULOSE ACETATE MEMBRANES,
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Technology.
H. Bokhorst, F. W. Altena, and C. A. Smolders.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, 8 Figs, 14 Ref, p 349-360 (1st. Vol of the Proc of the Intern Congress on Desalination and Water Reuse, Bahrain, Nov 29-Dec 3, 1981).

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, Cellulose acetate.

Cellulose acetate membranes were prepared from casting solutions containing dioxane as a solvent and varying concentrations (up to 6%) of maleic acid as an additive. Coagulation took place in water at different temperatures. The effect of these variables on membrane structure and membrane properties is related to two phenomena of phase separation in the system cellulose acetate/dioxane/water with gelation in the top layer and liquid-liquid phase separation in the sublayer of the membrane. A solution transport model is adopted which correlates membrane flux with the skin thickness and membrane salt rejection with the compactness (microstructure) in the skin. Effects of variables such as maleic acid concentration and coagulation temperature on the position of curves in the phase diagram and on membrane properties are discussed.
W84-00237

HOLLOW FINE FIBER VS. FLAT SHEET MEMBRANES - A COMPARISON OF STRUCTURES AND PERFORMANCE,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
J. K. Beasley, and R. E. Penn.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 361-372, 6 Fig, 24 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Membrane processes, *Polymers, Hollow fiber, Membranes, Flat sheet.

The reverse osmosis performance of polymeric membranes depends not only on the chemical structure of the polymer but also on the physical structure of the membrane. Percolation theory is used to describe water flux and salt passage as functions of the polymer density, or porosity, of the membrane. Water permeability increases with increasing porosity, or decreasing polymer density in the membrane. Salt passage is controlled primarily by the membrane polymer density in the surface layer on the feed side of the membrane. Experimental data on both hollow fine fiber and flat sheet membranes are consistent with the basic concepts of percolation theory.
W84-00238

PURIFICATION OF HIGH TEMPERATURE WATER BY THE REVERSE OSMOSIS PROCESS,
Tokyo Univ. (Japan). Inst. of Industrial Science.
S. Kimura, and T. Nomura.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 373-382, 11 Fig, 3 Ref. (1st. Vol of the Proc of the Intern Congress on Desalination and Water Reuse, Bahrain, Nov 29-Dec 3, 1981).

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Membranes, Water treatment, Hollow fiber, 'Hollosep', Brines.

For the high temperature desalination and purification possible use of two kinds of membranes was pursued. A dynamically formed membrane is fundamentally usable at high temperature, and a module was developed and tested. A commercially available module, hollow fiber type 'Hollosep', was found durable over 70C at 30 kg/sq cm. These modules were tested by treating the geothermal brine, that contained SiO sub 2 and NaCl. They worked well when the brine contained only ionic SiO sub 2, but was fouled by the colloidal SiO sub 2.
W84-00239

THE APPLICATION OF THIN FILM COMPOSITE MEMBRANES IN PLATE-AND-FRAME SYSTEMS FOR WATER PURIFICATION,
Danske Sukkerfabrikker, Nakskov. Driftteknisk Lab.
For primary bibliographic entry see Field 5D.
W84-00240

AN INVESTIGATION OF USING STATISTICALLY DESIGNED EXPERIMENTS AND A COMPUTER MODEL,
Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
A. M. El-Nashar, and J. S. Shih.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 397 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Membranes, *Desalination, Model studies, Computer models, Membrane formation parameters.

The results are outlined of an experimental program aimed at establishing the best formation parameters for dynamic Zr(IV)-PAA membranes formed on porous ceramic supports. Parameters investigated are: pressure, circulation velocity, Zr(IV) concentration, and PAA concentration. Twenty statistically designed experiments were conducted to evaluate the effect of these four parameters on the flux and rejection of the resulting membrane at the end of the formation procedure. The results were used in a multiple linear regression computer program BMD-PIR, which develops the measured values with an accuracy of plus or minus 2%. Using these models, it is possible to form a membrane with a given value of flux or rejection within their ranges. For the range of variables used in this study, the maximum membrane rejection was 91%, corresponding to a flux of 10 gpd/ sq ft (1.7 cm/hr) for 0.05 M NaCl and 800 psi (5.4 MPa). High rejection was obtained by increasing the membrane formation pressure and by increasing the PAA concentration. High flux can be achieved by increasing the formation pressure, by increasing the Zr(IV) concentration - up to 9.0 x 10 super -4M super -, and by increasing the circulation velocity.
W84-00241

THE PERFORMANCE OF THE 12,000 M SUPER 3/DAY SEAWATER RO PLANT AT JEDDAH, SAUDI ARABIA,
Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
A. M. El-Nashar, and I. Kutbi.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 399 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: Desalination, Desalination plants, Seawater plant, Reverse osmosis, Jeddah, *Saudi Arabia, Special wound elements.

The performance is outlined of the 12,000 cubic m/day seawater RO plant at Jeddah, Saudi Arabia, which started operation in February 1979. The feedwater has a 42,000-ppm TDS and a maximum seawater temperature of 32C. A first stage includes nine units, eight operating and one stand-by, and a second stage contains three units. The nine first stage and the three second stage RO units are each composed of 56 Fiberglass pressure tubes (Model 66 FRP-6) 150-mm diameter by 6.5 m long, each containing six spiral wound elements manufactured by UOP Fluid Systems Division. The plant uses Fluid System's polyamide thin film composite membrane element, Model 1501 TFC. The pretreatment is composed of dual media filtration, acid injection, sodium hexametaphosphate injection and cartridge filtration.
W84-00242

PRETREATMENT AND OPERATING EXPERIENCE ON REVERSE OSMOSIS PLANT IN THE MIDDLE EAST,
Paterson Candy International Ltd., Laverstoke (England).
D. Pepper.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 403-417, 2 Figs, 5 Tab, 1 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Pretreatment, Brackish water, Middle East.

The pretreatment methods which can be used to make a water suitable for satisfactory processing in a reverse osmosis plant are discussed. This discussion is followed by case histories of plants operating on various waters in the Middle East from normal brackish waters to very strong brackish water (12,000 mg/1 T.D.S.) containing H sub 2 S, and mobile plants for treating brackish and sea waters.
W84-00243

CONTROLLING BIOLOGICAL ACTIVITY IN A SURFACE WATER REVERSE OSMOSIS PLANT,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Haskell Lab. for Toxicology and Industrial Medicine.
G. E. Bettinger.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, 3 Figs., 4 Ref. p 419-424 (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, *Desalination plants, *Reverse osmosis, Biological fouling, Permasep B-9 super (R).

A plant, built in 1972, has a total of 24 permeators operating in 4 blocks which are reject staged 4:2. The feed water TDS is 475 milligrams per liter and the silt density index (SDI) after pretreatment is less than 3. Feed pressure is 400 psig and product pressure 10 psig, with an interstate pressure drop of 35 psig. The plant operates at a feed temperature of 20C and an overall conversion of 70%. The product is used for boiler feed and chemical process water. Since its inception this plant has exhibited a problem in maintaining the design product flows and the operating conditions evolved such that two banks of permeators operated for one week, and then a citric acid, formaldehyde cleaning procedure was used on the two banks the second week. The other two banks of Permasep super (R) units, which had been cleaned and sterilized the week before, were then used. The plant was able to operate under these conditions but the cost of manpower and cleaning chemicals required to maintain satisfactory product water flow and quality was excessive.
W84-00244

PRETREATMENT OF SEAWATER RO FEED BY MEANS OF COAGULATION-FILTRATION,
Kobe Steel Ltd. (Japan). Water and Wastewater Engineering Dept.
H. Tsuge, S. Suda, and T. Matsumura.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 425-436, 8 Fig, 2 Tab, 6 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination processes, Seawater, Pretreatment, *Reverse osmosis, *Coagulation, Hydrogen ion concentration, Coagulation-filtration.

The effect of pH of the filtrate on the head loss in the inline coagulation-filtration for the pretreatment of reverse osmosis seawater desalination was

investigated. The experiment was carried out using a double media filter with aluminum sulfate as a coagulant. The filtration characteristics were dependent on the pH of the filtrate. The rate of elevation in the head loss and the amount of suspended particles in the filtrate decreased with an increase in the pH, over the range of experimental conditions. The results were briefly considered in relation to the deposit morphology of suspended particles on the surface of the filter grain.
W84-00245

CHEMICAL TREATMENT FOR REUSE OF WASTEWATER EFFLUENTS IN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
For primary bibliographic entry see Field 5D.
W84-00246

SINGLE-PASS DESALINATION OF HIGH SALINITY SEAWATER WITH REVERSE OSMOSIS,
Toyabo Co. Ltd., Otsu (Japan). Katata Research Center.
H. Matsui, H. Matsumoto, H. Kuzumoto, M. Sekino, and Y. Nimura.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 441-447, 2 Fig, 4 Tab, 2 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: Desalination, Desalination plants, Reverse osmosis, Membrane processes, 'Hollosep', Salinity, Seawater.

Two types of new 'HOLLOSEP' have been developed for single-pass desalination of high salinity seawater. One is a high pressure and high temperature module, type 'HPT'. The performance of this new type HOLLOSEP is analyzed in the case of desalination of high salinity seawater under a high pressure of 75kg/sq cm G at high temperature of 40C. The operation costs can be reduced by this high pressure and high temperature operation system. The other is a large size module containing five elements of 12 inches diameter, type 'JM-12'. This module has been developed to reduce the water cost by enlarging the diameter and the length of a vessel coupled with the improvement in water flux rate of the hollow fiber membranes. The fresh water productivity of this module is 150 cu m/day under the conditions of 3.5% NaCl feed water, 30% product water recovery at 55kg/sq cm G.
W84-00247

DEVELOPMENT OF THE PEC-1000 COMPOSITE MEMBRANE FOR SINGLE-STAGE SEAWATER DESALINATION AND THE CONCENTRATION OF DILUTE AQUEOUS SOLUTIONS CONTAINING VALUABLE MATERIALS,
Toray Industries, Inc., Otsu (Japan).
M. Kurihara, N. Harumiya, N. Kanamaru, T. Tonomura, and M. Nakasatomi.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 449-460, 11 Figs, 2 Tab (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination plants, Anion exchange, *Membranes, *Reverse osmosis, Single stage seawater desalination, Piezodialysis, Mosaic membranes, Potable water.

The PEC-1000 membrane element has a capability to produce the potablewater economically by a single-stage seawater desalination and the possibility in the application to the concentration and recovery of valuable materials. The basic performance is described of the PEC-1000 element and the durability test results on the single-stage seawater desalination, both in the low and high salinity seawater feed with high feedwater temperatures. The membrane performance is described by concentrating water soluble valuable organic materials of low molecular weight and valuable inorganic compounds.
W84-00248

PIEZODIALYTIC TRANSPORT ACROSS CHARGE-MOSAIC MEMBRANES,
Wroclaw Technical Univ. (Poland). Inst. of Environmental Engineering.
G. Blazejewska-Wisniewska, and T. Winnicki.
In: Desalination, Vol 38, Nos 1/2/3, p 461-471, 9 Fig, 7 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination plants, Anion-exchange, *Membrane processes, Piezodialysis, Mosaic membranes.

The highest concentrations are obtained for symmetric electrolytes and membranes of the second series. When the capacity of the anion-exchange resins in those membranes increases, so does the concentration of the solutions. In second-series membranes the influence of ionic polarization was the least as compared to the remaining two series. All of the membranes under study permit concentration of asymmetric electrolytes only at an initial concentration of 0.05 kmol/cu m. Retention of bivalent ions by charge-mosaic membranes seems to be promising in that it suggests the possibility of separating bivalent from monovalent ions. The optimum parameters at which the concentration effects were the highest, are the following: pressure, 11.3 MPa; initial concentration of the electrolyte, 0.05 kmol/cu m.
W84-00249

THE FT-30 SEAWATER REVERSE OSMOSIS MEMBRANE-ELEMENT TEST RESULTS,
FilmTec Corp., Minneapolis, MN.
R. E. Larson, J. E. Cadotte, and R. J. Petersen.
In: Desalination, Vol 38, Nos 1/2/3, p 473-483, 6 Figs, 1 Tab, 4 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Desalination apparatus, *Reverse osmosis, *Membranes, Thin-film composite, FT-30.

A thin-film composite reverse osmosis (RO) membrane has been developed that provides excellent performance when used in single-pass seawater systems. This membrane, designated FT-30, gives superior performance in such areas as flux, salt rejection, chemical stability, and microbiological resistance. In addition, it is resistant to some oxidizing disinfectant agents, although it is not fully resistant to chlorine; elements fabricated from the membrane have shown damage after 2,000 to 2,500 hours exposure to seawater at 0.5 milligrams per liter (mg/l) active chlorine. The membranes can operate continuously at active chlorine concentrations below 0.2 mg/l. Several long-term studies were carried out at the OWRT Wrightsville Beach Test Facilities. In actual trials in seawater systems, salt rejections as high as 99.5% and fluxes of 23 gfd have been obtained when tested at 800 psi and 25C. Some of the elements have been in continuous operation for over 4,000 hours with no deterioration in salt rejection and with only the normal flux decline usually associated with compaction and scaling. Other elements have been installed in small seawater systems with normal intermittent use for almost two years with no serious loss in performance.
W84-00250

BUILDING AND COMMISSIONING THE 3.0 MGD SEAWATER RO PLANT FOR KEY WEST, FLORIDA,
Water Services of America, Inc., Milwaukee, WI.
W. W. Boesch.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 485-496, 11 Figs. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Membrane processes, Key West, Florida, Seawater.

The fast deliveries and the reliability of a seawater reverse osmosis plant has been demonstrated. The performance of a large plant using the hollow fiber polyamide membranes shows that good potable water can be obtained through a single pass design rather than the more costly two pass design. The comparison between thermal plants and seawater RO points up large contrasts in simplicity of design, compactness, delivery time, reliability and cost.
W84-00251

UTILIZATION OF THE WASTE CONCENTRATED SEAWATER IN THE DESALINATION PLANTS,
Asahi Glass Co. Ltd., Chiba (Japan).
For primary bibliographic entry see Field 5D.
W84-00252

WATER SOFTENING BY DIFFUSION USING CATION EXCHANGE MEMBRANES,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
For primary bibliographic entry see Field 5D.
W84-00253

DEMINERALIZATION BY ELECTRODIALYSIS USING AMPHOLYTIC ION-CONDUCTING SPACERS,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
For primary bibliographic entry see Field 5D.
W84-00254

DESALTING 36,000 PPM WELL WATER WITH ELECTRODIALYSIS - A 5-YEAR REPORT,
Ionics, Inc., Watertown, MA.
H. C. Valcour, Jr., and K. D. McElhinney.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 529-536, 2 Figs, 2 Tab, 1 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Manama, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Electrodialysis, Anion membranes, Well water.

The 36,000-ppm TDS well water is saturated with calcium sulfate and contains high levels of hydrogen sulfide (reported as high as 190 ppm). The 42,000-USGPD plant has now been in service for nearly 5 years and has never failed to provide the potable water needs of the desert camp that it serves. The operation of the pretreatment section of the plant has been modified to reduce the amount of lime fed to the solids contact clarifier, thereby reducing the quantity of acid required for pH reduction of the feed water. The only major modification to the ED portion of the plant has been the installation of new type anion membranes. The membrane stacks are now primarily equipped with two types of anion membranes, both of which operate at a lower electrical resistance and higher ion transfer efficiency. The result of these more efficient anion membranes is a lower power consumption and higher production rate. Improvements to the electrode system have resulted in continuous membrane stack operating periods of over 6000 hours between disassemblies.
W84-00255

TREATING BAHRAIN ZONE C GROUNDWATER USING THE EDR PROCESS,
Ionics, Inc., Watertown, MA.
D. F. Brown.
In: Desalination, Vol 38, Nos 1/2/3, p 537-547, November 1981, (1st. Vol of the Proceedings of the International Congress on Desalination and Water Reuse, Manama, Bahrain, November 29-December 3, 1981). 3 Tab, 3 Fig, 3 Ref.

Descriptors: *Desalination, Desalination plants, *Electrodialysis, Desalination apparatus, Membrane processes, Bahrain, Electrodialysis reversal.

Developing and applying efficient water desalination technologies for treatment of Zone C groundwater appears to be an essential factor in maintaining an adequate water supply for the Island of Bahrain. The quality of this source (11,000 ppm TDS) will increase capital and operating costs of

desalting systems as compared to units currently operating on the Zone B brackish water sources. Conceptual design studies have shown that EDR is directly applicable to Zone C desalination requirements. Pertinent operating characteristics are reviewed of the Mediterranean installation and estimated operating parameters and costs for Bahrain Zone C water treatment are projected. Factors contributing to the improvement in EDR system operating efficiency which make treatment of the Zone C type water feasible are: new aliphatic membranes which improve electrical efficiency, a special electrode Clean-In-Place system which reduces acid consumption for periodic stack cleaning, and a new time phased rversal system which increases efficiency of polarity reversal in multistage units needed to desalt 10-12,000 ppm TDS feed waters. The EDR process offers an attractive, economical alternative for the Zone C desalination requirements.
W84-00256

PARAMETRIC TESTS OF AN ELECTRODIALYSIS REVERSAL (EDR) SYSTEM WITH ALIPHATIC ANION MEMBRANES,
Ionics, Inc., Watertown, MA.
D. Elyanow, R. G. Parent, and J. R. Mahoney.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 549-565, 3 Figs, 4 Tab (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Manama, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Electrodialysis, Desalination apparatus, EDR, Roswell Test Facility, Aliphatic anion membranes, Aquamite X EDR.

During 1980, parametric studies were performed to compare the performance of aliphatic anion membranes to standard anion membranes in an electrodialysis reversal (EDR) system. An Ionics AQUAMITE X EDR unit was used to desalt a high sodium chloride, 4100 mg/l TDS feed water. During these tests, the product salinity averaged 388 mg/l at an average production rate of 25,800 USGPD. The use of aliphatic membranes reduced the desalting energy consumption from 8.1 kwh/kGal with standard membranes to 6.8 kwh/kGal with aliphatic membranes at 75% recovery and, at 92% recovery, from 14.6 kwh/kGal for standard membranes to 11.0 kwh/kGal for the aliphatics. Slightly higher water recoveries were also possible with the aliphatic membranes as they exhibited less water transfer. A maximum recovery of 94% was obtained without operational problem despite calcium sulfate (gypsum) supersaturation levels of up to 165% in the waste stream. The following characteristics are desirable for an EDR plant to treat a high sodium chloride 4100-ppm water: (1) Aliphatic anion membranes for reduced energy consumption, (2) Separate feed for brine and electrode flows for nearly complete recovery of a limited higher quality brackish water source, and (3) 30-minute reversal cycle to improve production and increase recovery.
W84-00257

DESALINATION OF SEA WATER BY AN ELECTRODIALYSIS-REVERSE OSMOSIS HYBRID SYSTEM,
Forschungsinstitut Berghof G.m.b.H., Tuebingen (Germany, F.R.).
H. Schmoldt, H. Strathmann, and J. Kaschemekat.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 567-582, 11 Figs, 3 Ref. 1st. Vol of the Proc. of the

Descriptors: *Desalination, Desalination plants, Desalination apparatus, *Reverse osmosis, Electrodialysis.

In the RO desalination of sea water with salt contents in excess of 4.0% TDS, a two-stage procedure is necessary today to guarantee reliable, longterm operation and satisfactory product water quality. In general, in a two-stage plant, the salt concentration of the sea water is reduced to about 2000 to 4000 ppm in the first stage and to less than 500 ppm in the second stage. The advantages of the two-stage over a one-stage system are high reliability and possibly lower costs.
W84-00258

ENERGY-SAVING ELECTRODIALYZER FOR SEA WATER DESALINATION,
Tokuyama Soda Co. Ltd. (Japan).
T. Mizoue, Y. Takasaki, Y. Tani, S. Urabe, and E. Asada.
Desalination, Vol 38, Nos 1/2/3, November 1981, p 583 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Manama, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Desalination apparatus, *Electrodialysis, Seawater, Skid-mounted electrodialyzer.

An energy-saving skid mounted electrodialyzer was developed for sea water desalination. This equipment is suitable for making fresh water for drinking and industrial use. To desalinate 25C sea water and turn out one ton of product water. This equipment consumes only 8.5 KWH of electricity and 0.09 Kg of concentrated sulphuric acid. Low energy consumption is achieved by adoption of low electric resistance membranes, new spaces and new designed one pass type system. Low running cost, easy maintenance and low initial installment cost place the equipment good position in the desalination field. And also we applied high temperature electrodialysis up to 50C of sea water and get figure 6.0 KWH for one ton of product water.
W84-00259

WATER REQUIREMENTS OF AN INLAND NUCLEAR POWER STATION, ENGINEERING AND ECONOMIC ASPECTS,
Israel Electric Corp. Ltd., Haifa.
A. Beck, and M. Schaal.
Desalination, Vol 40, Nos 1/2, January 1982, p 19-24, 2 Tab, 4 Ref.

Descriptors: Water requirements, *Desalination, *Nuclear Powerplants, Engineering, Economic aspects, *Israel, Cooling towers.

Water requirements for construction and operation of a 950 MWe nuclear power plant are estimated. For the bulk of water needed, i.e. condensor cooling, quantities assessed are 12.5 million cu m/year for sea water and 35 million cu m/year for fresh water. Breakeven water costs are calculated below which use of wet cooling towers is more economical than dry cooling towers. Desalinated water costs (70 cents/cu m) are lower than breakeven costs ($1.42/cu m) i.e. it is likely to be more economical to desalt water using some form of wet, rather than dry, cooling towers. It is even more economical to use sea water makeup without desalination but with proper design and choice of materials for cooling towers.
W84-00260

WATER RESOURCES IN ISRAEL AND THE NEED FOR DESALINATION,
Ministry of Agriculture, Tel-Aviv (Israel). Water Commission.
M. Ben Meir.
Desalination, Vol 40, Nos 1/2, January 1982, p 15-18.

Descriptors: *Desalination, Seawater, *Water resources development, Water policy, Planning, *Israel.

Considering the various factors involved in determining timing for introduction of seawater desalination in Israel and the desirable scope, it is presently assessed that a 50-100 MCM/yr desalination plant should operate by the end of the century. The appropriate timing for the introduction of seawater desalination in Israel, and the scope of such operations, can be determined only after due consideration of the following topics: (1) climatic conditions, (2) hydrological situation, (3) possibilities for water resource development, (4) macroeconomic implications of water shortage, (5) the planned geographic and demographic distribution of the population, (6) physical planning in the light of national and social goals, (7) the need to ensure food supplies, and (8) water in relation to the geopolitical situation.
W84-00261

WATER FROM FOSSIL AQUIFERS AS A POTENTIAL SUPPLY SOURCE FOR SOLAR DESALINATION PLANTS ON A REGIONAL SCALE,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
A. Issar, and G. Oron.
Desalination, Vol 40, Nos 1/2, January 1982, p 25-32, 1 Fig, 8 Ref.

Descriptors: *Water supply, *Desalination, Desalination plants, *Solar desalination, *Israel, Hydrogeology, Hydrogeochemistry.

Studies of the hydrogeology and hydrogeochemistry of the water in the Judea Kurnuk and Arad Group aquifers in the Negev (Cenomanian, Lower Cretaceous and Jurassic) reveal that under a large area of the Negev an aquiferous section 1000- to 1500-m thick is saturated with brackish water. Data derived from oil and water wells enabled the mapping of the various water groups which in turn made it possible to map the chemical composition of the water in the different regions. The potential quantities of water, from the point of view of storage, are in the order of hundreds of billions of cubic meters. Annual pumping amounts, however, are a function of management policy. The annual pumping potential for the next 30 years from the Kurnub Group (Lower Cretaceous) is about 60-100 million cu m, with an allowance of 20-100 m for the reduction of head. The cost of desalination may be reduced if one takes water whose salinity is a little above the threshold of direct application for agricultural use and mixes it with the distilled water supplied by the solar distiller. The chances of achieving even lower costs for distilled water are promising as the water pumped has an average temperature of 40C. Thus, the efficiency of the solar stills may be greater, and may even enable night distillation to take place. The application of solar distillation thus appears promising in the Arava, where the special climatic conditions give a marginal benefit value of $1.00 p/cu m of water for winter vegetables.
W84-00262

PRESENT AND FUTURE ENERGY ASPECTS IN VC, MED SINGLE AND DUAL PURPOSE DESALINATION PLANTS,
Israel Desalination Engineering Ltd., Tel-Aviv.
J. Weinberg, and U. Fisher.
Desalination, Vol 40, Nos 1/2, January 1982, p 49-61, 2 Fig, 8 Tab, 3 Ref.

Descriptors: *Desalination, Desalination plants, Distillation, *Vapor compression, *Multieffect distillation, Heat transfer.

The specific energy consumption as well as investment for present vapour compression (VC) and multieffect distillation (MED) processes are demonstrated. Power consumption for coal dual-purpose stations is 6.5-7.4 kWh/cu m, while for nuclear stations it goes down to 5.1-6.1 kWh/cu m. Improvements in heat transfer and other future modifications may lead to even lower values, i.e., 5.5-6.4 kWh/cu m and 4.4-5.4 kWh/cu m in case of nuclear dual-purpose stations. The cases of VC and single-purpose MED plants are discussed as well. Efficient VC units which use waste energy produce water with energy demand of 8 kWh/cu m. The role that capital costs play in the evaluation of plant expenses is discussed too. In plants where aluminium heat transfer tubes are installed, the fraction of energy used for aluminium production out of the total investment will remain stable, because of improvements in aluminium manufacturing processes. Enhanced heat transfer surfaces with inexpensive additional modifications should be developed. It is worthwhile to check the extension of a VC process which is prefered over MED single-purpose plants for up to 2-mgd enterprises.
W84-00263

AVAILABLE ELECTRICITY LOSS FOR LOW GRADE HEAT,
Israel Electric Corp. Ltd., Haifa.
M. Schaal.
Desalination, Vol 40, Nos 1/2, January 1982, p 77-85, 4 Fig, 5 Ref.

Descriptors: *Desalination, Electric powerplants, Dualpurpose plants, Turbines, Specific energy demand.

A method was developed calculating loss of available electricity production caused by elevated back pressures used in dual purpose powerplants. The method is based on practical data provided by turbine manufacturers. The method is applied to calculate specific energy demands for desalinated water. It is assumed that the steam is supplied from turbine exhaust to desalination plant at a moderate pressure of 12 in of Hg sub (abs).
W84-00264

COST OF MARGINAL ENERGY CHARGEABLE TO DESALINATION IN THE ISRAEL ELECTRIC CORP. GENERATING SYSTEM,
Israel Electric Corp. Ltd., Haifa.
M. Schaal, A. Schwartzman, and A. Angel.
Desalination, Vol 40, Nos 1/2, January 1982, p 87-94, 1 Fig, 6 Tab, 1 Ref.

Descriptors: *Desalination, Marginal costs, *Electric power costs, Electric powerplants, Costs, *Israel, Ashdod, Tel Aviv, Haifa.

The marginal kWh cost was calculated by the addition of 20 MW to the base load curve and by the division of the additional fuel consumption by the additional demand. The result was highly sensitive to the growth rate and expansion program. The marginal cost ranges between 47.4 to 60.5 mills/kWh as compared to average IEC energy cost ranging between 22.5 to 31.5 mills/kWh. The marginal cost is that which corresponds to the base load. To get the specific energy cost for the desalted water, the marginal kWh cost should be multiplied by the specific energy demand.
W84-00265

TRENDS IN THE APPLICATION OF SOLAR ENERGY TO WATER DESALINATION,
R. A. Brosh.
Desalination, Vol 40, Nos 1/2, January 1982, p 95-102.

Descriptors: *Desalination, *Solar energy, Distillation, Electric power costs.

Solar desalination is more expensive than fossil energy because of high capital costs for collecting systems. The types of solar energy processes are: (a) Applied to direct distillation of water, energy is collected and used in the same vessel, (b) Solar energy is collected in one unit and desalination performed in separate unit. Some calculations are made indicating development work required for successful application of solar energy.
W84-00266

SOLAR ENERGY AS A SOURCE FOR PRODUCTION OF POWER AND DESALINATED WATER,
Israel Desalination Engineering Ltd., Tel-Aviv.
A. Ophir, and N. Nadav.
Desalination, Vol 30, Nos 1/2, January 1982, p 103-124, 3 Fig, 8 Tab, 2 App, 13 Ref.

Descriptors: *Desalination, *Ponds, *Solar energy, Dual purpose plants, Dead Sea, Mediterranean.

A detailed calculation utilizing solar ponds for generation of electricity and seawater desalination are presented. Three cases are studied: single purpose electricity generation plants at the Dead Sea and Mediterranean regions and a dual purpose plant for electricity generation and seawater desalination. The results indicate that where a price of 0.6-0.7 $/ton can be economically justified, the dual purpose plant becomes the most attractive of the alternatives compared for electrical power generation as well.
W84-00267

DESALINATION PLANT USING LOW GRADE GEOTHERMAL HEAT,
Israel Desalination Engineering Ltd., Tel-Aviv.
A. Ophir.
Desalination, Vol 30, Nos 1/2, January 1982, p 125-132, 1 Fig, 1 Tab, 1 Append.

Descriptors: *Desalination, Desalination plants, Distillation, Brines, *Geothermal studies, *Israel.

Based on the possibility that a geothermal hot brine source may be found in Israel, a preliminary economic study using such a source for desalination is presented. The two cases evaluated are for a 110C and 130C brinesources. The cost of desalinated water from a geothermal brine source is 0.5 $/ton. Such a low price for seawater desalination can now be achieved only with large multi-effect distillation plants coupled with big power stations using low back pressure steam.
W84-00268

GEOTHERMAL RESOURCES IN ISRAEL,
Israel Inst. of Petroleum Engineering, Tel-Aviv.
L. Koifman.
Desalination, Vol 40, Nos 1/2, January 1982, p 133-134.

Descriptors: *Geothermal resources, Geophysics, Thermal springs, *Israel.

There are no significant geothermal anomalies in Israel. A survey of the temperatures registered on electric logs run in the oil exploration wells shows that the geothermal gradients encountered are normal, ranging from 1.7 to 2.2C/100 m in shaly formation and from about 3.0 to 4.0C/100 m in massive carbonated layers. Only in Dvora (Mount Tabor) at depths below 4000 m do we reach gradients of larger magnitudes. It was established beyond any reasonable doubt that the top Jurassic in the coastal plain, at depths of about 2700 m is at a temperature of 110C or more.
W84-00269

DESALINATION AT INLAND SITES,
Israel Desalination Engineering Ltd., Tel-Aviv.
A. Gendel.
Desalination, Vol 30, Nos 1/2, January 1982, p 135-142, 3 Fig, 3 Ref.

Descriptors: *Desalination, Desalination plants, *Dual-purpose plants, Costs, *Mediterranean-Dead Sea canal.

Locating a dual purpose desalination plant along the Mediterranean-Dead Sea Canal is feasible and should be seriously considered. The cost of water produced in the inland site will be higher by a few percentage points than in the sea side case. This cost would be considerably reduced if the product water would be mixed with locally available brackish water.
W84-00270

PRELIMINARY CONSIDERATIONS OF COMBINING A LARGE REVERSE OSMOSIS PLANT WITH THE MEDITERRANEAN-DEAD SEA PROJECT,
Mekoroth Water Co., Tel Aviv (Israel).
P. Glueckstern.
Desalination, Vol 40, Nos 1/2, January 1982, p 143-156, 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Gravity flow, *Mediterranean-Dead Sea Canal.

The potential benefits were investigated of a reverse osmosis plant designed in conjunction with the Mediterranean-Dead Sea project in order to utilize gravity pressure as partial energy source for the desalting process. Energy requirements of alternative conceptual operating schemes were evaluated and compared to those of conventional reverse osmosis. Overall comparative economics of conventional and conjunctive systems were analyzed and discussed.
W84-00271

OPERATION OF A HORIZONTAL TUBE BRINE CONCENTRATOR,
Israel Desalination Engineering Ltd., Tel-Aviv.
J. Weinberg, and Y. Rotstein.
Desalination, Vol 40, Nos 1/2, January 1982, p 159-168, 2 Tab, 2 Fig, 18 Refs.

Descriptors: *Desalination, Desalination apparatus, *Scaling, Wastewater treatment, Evaporators, Concentrator.

An apparatus to concentrate solutions was developed using know how on seawater evaporators and treatment of sea and product water. A pilot plant at the Research Center in Tel-Baruch, near Tel Aviv has been operated since the middle of 1977. The plant is a single effect concentrator coupled to a condenser, with a capacity of up to 400 kg vapour per hour. The prevention of scale (Calcium sulphate, Calcium carbonate or other constituents) has been carried out by combined techniques of seeding process plus a threshold treatment.
W84-00272

ELECTRODIALYSIS UNIT: OPTIMIZATION AND CALCULATION OF ENERGY REQUIREMENT,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Div. of Membranes and Ion-Exchangers.
E. Korngold.
Desalination, Vol 40, Nos 1/2, January 1982, p 171-179, 2 Fig, 3 Tab.

Descriptors: *Desalination, Desalination plants, *Electrodialysis, Electric power demand.

An industrial unit which optimizes the parameters of the electrodialysis process has been developed. The total energy requirement with this unit is about 1.2 kWh/cu m for brackish water of 2400 ppm and 3.3 kWh/cu m for water of 5000 ppm. For sea water desalination the system may be optimized by operating it with thin cells (0.4 mm) and thin polyethylene membranes (0.1 mm). In such a system the energy requirement for the desalination of sea water will be 12 k/Wh/cu m for operation at 20C and 6.7 kWh/cu m at 70C.
W84-00273

EFFECT OF THE ENERGY CRISIS ON WATER DESALINATION AND WASTE WATER RECYCLING BY ION EXCHANGE,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Div. of Membranes and Ion-Exchangers.
Y. Egozy, and E. Korngold.
Desalination, Vol 40, Nos 1/2, January 1982, p 181-189, 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Desalination, *Ion exchange, Water reuse, Wastewater renovation.

The cost, and its breakdown into components, of an ion exchange process for desalination and waste water recycling is presented. Using the effect of the 1973-4 jump in the price of energy on the cost of treatment, the expected future trend is calculated. The net energy component in ion exchange water treatment is 14.5% when lime is used for regeneration, and 17% when NaOH is used. The substitution of lime for NaOH reduces the treatment cost and makes the ion exchange process an economical method for desalination and waste water recycling. 'Non-conventional' approaches such as a continuous fixed-bed process, a system including recycling of regenerants, regeneration thermally or with waste acids are also discussed.
W84-00274

PRODUCTION OF ELECTRICAL POWER FROM CONCENTRATED BRINES,
Israel Desalination Engineering Ltd., Tel-Aviv.
N. Nadav, and A. Ophir.
Desalination, Vol 40, Nos 1/2, January 1982, p 197-211, 1 Fig, 2 Tab, 6 Ref.

Descriptors: Electric power, Brines, Brackish water, Falling film horizontal tube absorption condenser, Flash chamber, Condensers, Flash evaporation, Dead Sea, Israel.

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

The price of electrical power, produced by burning fossil energy sources has reached a level where other alternatives become competetive. One of these alternatives is dilution of concentrated brines. It is possible to regard these very concentrated brines (as well as fossil fuels) as an accumulated solar energy radiated over millions of years, causing brines to attain a very high salt concentration. Dilution of these brines results in releasing heat of dilution and the very low vapor pressure of these brines can be utilized as a driving force for vapor condensation. A source of highly concentrated brine is available at the Dead Sea Works where 88 million tons of such brine is today returned to the Dead Sea as waste streams. Dilution of this brine at a ratio of three (brine) to one (vapor) by weight can supply 40 MW of electrical power. The proposed process is based on the use of two well-proven process elements, a falling film horizontal tube absorption condenser and a flash chamber.
W84-00275

THE JOINT U.S.-ISRAEL DESALINATION PROJECT STATUS REPORT AND THE IMPACT OF RISING ENERGY COSTS ON THE PROGRAM,
Israel-U.S. Desalination Project Authority, Tel-Aviv.
A. Peled, and J. Finke.
Desalination, Vol 40, Nos 1/2, January 1982, p 217-223, 9 Figs.

Descriptors: *Desalination, Desalination plants, *Multieffect distillation, Seawater, *Distillation.

The Joint U.S.-Israel Desalination Project is discussed which was initiated in 1975 with the main objective of developing, designing, constructing and demonstrating the operation of a large -5/10 MGD - MED seawater desalination plant, using exhaust heat from an existing 50-MW steam power plant.
W84-00276

THE IMPACT OF DESALINATED WATER QUALITY ON ENERGY COSTS,
Italconsult, Rome (Italy).
E. Gabrielli.
Desalination, Vol 40, No 3, p 391-394, March 1982. (Comprising the Round Table Conference on Influence on Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980). 4 Ref.

Descriptors: *Desalination, Seawater, *Energy, *Costs.

Lack of clarity in defining the scope of work of a desalination process may often lead to questionable or meaningless results when economic analysis is performed. In particular the incidence of the energy cost cannot be compared when different plants treat the same raw material, in this case seawater, but yield different products; that is to say waters which have residual TDS differing by orders of magnitude and which are not therefore necessarily equivalent for the application in question. Criteria are suggested for ensuring clearer definition of the problem in order to help evolve a methodology which allows processes to be compared on a perfectly sound economic basis.
W84-00277

DEVELOPMENT OF DISTILLATION PROCESSES RESPONSIVE TO ENERGY COST ESCALATIONS,
California Univ., Berkeley. Sea Water Conversion Lab.
H. H. Sephton.
Desalination, Vol 40, Nos 3, p 375-384, March 1982. (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), 5 Fig, 20 Ref.

Descriptors: *Desalination, Desalination plants, *Desalination apparatus, *Distillation, Energy, Costs.

Recent developments in distillation processes that respond to the continuing escalation in energy cost are reviewed. The most effective developements are considered to be those providing increased performance ratios and heat transfer rates, the utilization of waste heat or low grade heat including insolation, and improvements in the reliability of equipment and processes within reasonable capital cost levels. Suggestions are offered as themes for future research and development in each of these area.
W84-00278

ENERGETIC ASPECTS OF THE FOULING OF MSF DESALINATION PLANTS WITH AND WITHOUT THE USE OF ON LOAD BALL CLEANING SYSTEM,
K. Eimer.
Desalination, Vol 40, No 3, p 363-372, March 1982. (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), 1 Tab, 8 Fig, 18 Ref.

Descriptors: *Desalination, Desalination plants, *Multistage flash, Energy, Fouling, Load ball cleaning system, Scaling.

Multi stage flash (MSF) desalination plants are designed with specific permissible fouling factors. When these conditions are met, the performance is said to 'meet design'. With single-purpose desalinators, fouling of the brine heater can be compensated for by increasing the steam pressure without substantial increase of heat consumption and within the limits of the boiler pressure. With dual-purpose desalinators, the brine heater pressure will influence the efficiency of the turbine process. Fouling of the heat recovery section increases the heat consumption of the MSF process. The distillate production can be maintained within the limits of the boiler. Typical 'design fouling factors' have been compiled from literature. The influence of fouling factor on specific heat consumption has been calculated for typical MSF design conceptions, as well as the increase of water costs per cu m with different fuel prices. The costs of various scale prevention methods have been evaluated. The effectiveness of such countermeasures can be quantified by plant experience. This analysis of cost/return gives a basis for a correct economic comparison.
W84-00279

SEAWATER REVERSE OSMOSIS WITH ENERGY RECOVERY,
Esmil International B.V., Amsterdam (Netherlands).
W. A. G. Hoeting.
Desalination, Vol 40, No 3, p 357-361, March 1982. (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), 2 Tab, 1 Fig.

Descriptors: Desalination, Desalination plants, Reverse osmosis, Seawater, Energy recovery, Porto Sauto, Madeira Islands.

The Porto Santo seawater reverse osmosis plant has been designed to provide per day 500 cu m of potable water with a total dissolved solids content of 500 ppm from seawater with a total dissolved solids content of about 34000 ppm. The plant consists of four independent units with an output of 125 cu m per day each. Three units are fed by high pressure pumps equipped with electro-motors and one unit by a high pressure pump equipped with a hydro-turbine. The high pressure reject stream from each unit is directed into a manifold pipe which powers the hydroturbine. In this way power consumption of the high pressure pump is reduced by 25%. Without energy recovery consumption would have been 7.5 kWh/cu m and with the installed turbine this is as low as 5.6 kWh/cu m of product.
W84-00280

HIGH TEMPERATURE DISTILLATION PROCESS WITH SEA WATER FEED DECALCIFICATION PRETREATMENT,
Aquila Univ. (Italy). Ist. di Chimica Applicata ed Industriale.
D. Barba, G. di Giacomo, F. Evangelista, and G. Tagliaferri.
In: Desalination, Vol 40, No 3, p 347-355, March 1982. (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Producion during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), 1 Tab, 6 Fig, 13 Ref.

Descriptors: *Desalination, Desalination plants, Distillation, Ion exchange, Seawater, *Pretreatment of water, *Cation exchange.

The performance ratio of a desalination plant can be increased to reach 16-18 by coupling it with a decalcification pretreatment by ion exchange of the sea-water make-up, thus making MSF comparable with RO from an energy point of view. A new strong cationic resin DECAL has been tailored; its main features are high selectivity towards the calcium ion and low concentration of the regenerating brine. These characteristics make it compatible with the normal operating range of multiflash plants and very suitable for the above service, when compared with other resins. The optimum coupling conditions of the whole plant, lie between 140 and 150C for the top brine temperature and 2 to 2.5 for the brine concentration factor. In these conditions it is possible to operate with a sea-water resin bed ratio higher than 20.
W84-00281

INVESTMENT COSTS AND ENERGY CONSUMPTION OF THE MSF/FBE IN COMPARISON WITH THE MSF,
Esmil International B.V., Amsterdam (Netherlands).
J. P. P. Tholen.
Desalination, Vol 40, No 3, p 341-345, March 1982. (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, Septebmer 1980), 3 Tab, 3 Fig.

Descriptors: *Desalination, Desalination plants, *Distillation, *Multistage flash, Fluidized bed heat exchanger, Costs, Energy loss.

The use of the MSF process in seawater desalination is broad because of simplicity and reliability and an improvement of this process has been proven in the use of the fluidized bed heat exchanger. The choice of most economical gain ratio of a multistage flash evaporator is very dependent on energy cost, i.e. steam- and electricity cost. Because of lower investment and electricity costs the MSF/FBE has always lower product water cost than the MSF with equal gain ratio.
W84-00282

TRENDS IN THE MAJOR COST COMPONENTS OF MSF DESALTING AND THEIR IMPLICATIONS FOR FUTURE THERMAL DESALTING PLANT,
Binnie and Partners, London (England).
F. C. Wood.
In: Desalination, Vol 40, No 3, p 327-337, March 1982 (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), 4 Tab, 3 Fig, 7 Ref.

Descriptors: *Desalination, Desalination plants, *Distillation, Multistage flash, *Posts, Reverse osmosis.

The capital and operating costs of multistage flash (MSF) seawater desalters have increased drastically over the past decade. Analysis of trends in their major construction and operational costs permits conclusions to be drawn concerning the direction of future developments. If present trends continue, arid, oil-producing countries will require plants of low initial cost, high reliability and ease of operation, rather than new and advanced desalting concepts. On the other hand, oil-importing countries needing desalting must develop less fuel-intensive processes. Although seawater reverse osmosis can meet these needs, a market for dual-purpose plant of high Performance Ratio will persist, particularly where flexibility of operation is required. Hybrid desalters, combining power-using and thermal desalting techniques, will be developed in these countries. Mechanical vapour compression combined with multiple-effect evaporation and MSF feed preheating is one such process.
W84-00283

SEAWATER DESALTING ENERGY REQUIREMENTS AS A FUNCTION OF VARIOUS LOCAL CONDITIONS,
Burns and Roe, Inc., Oradell, NJ.
A. C. F. Ammerlaan.
In: Desalination, Vol 40, No 3, March 1982 (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), p 317-326, 10 Figs.

Descriptors: Desalination, Desalination plants, Vapor compression, Multistage flash, Reverse osmosis, Energy efficiency.

Energy consumption has been of prime concern to the equipment designer. With today's energy costs accelerating at an unprecedented rate, energy efficiency of desalting equipment is getting even more attention. However, local conditions have a considerable effect upon the ultimate selection and design of almost every desalting plant. Once these have been taken into account, by establishing the economic optimum and desired safeguards for the specific local conditions, energy efficiency of the desalting equipment usually is considerably less than the maximum that conceivably could be achieved. One finds that the inventors' and designers' efforts to reduce energy requirements certainly have not been in vain but, on the other hand, can be severely diluted by compromises necessitated by local conditions. Some of these conditions are explored along with their effects upon the energy efficiency of seawater desalting plants for the desalting processes: vapor compression, multistage flash, and reverse osmosis.
W84-00284

COST OF PRODUCING POWER AND WATER IN A COMBINED POWER STATION AND SEAWATER DESALINATION PLANT,
Abu Dhabi National Oil Co. (United Arbab Emirates).
R. Al-Assar, H. E. Homig, and K. Maurath.
In: Desalination, Vol 40, No 3, March 1982 (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), p 311-316, 2 Figs, 1 Tab.

Descriptors: *Desalination, Desalination plants, *Dual purpose plants, Powerplants, Seawater desalination, Electric power costs, *Costs.

The Ruwais Utilities complex is taken as an example to show how the relationship between power and water costs for a dual-purpose plant can be represented in a nomogram. The preparation of such a nomogram for a specific case is simple in principle, but calls for a considerable amount of computing because the cost calculations have to be performed for a large number of variants. This task is greatly facilitated by using suitable EDP programs.
W84-00285

AN EVALUATION OF THE ENERGY REQUIREMENTS OF DESALINATION PROCESSES ON THE BASIS OF THE FUEL-USE PERFORMANCE RATIO,
I. Kamal, and G. F. Tusel.
In: Desalination, Vol 40, No 3, March 1982 (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), p 283-295, 5 Figs, 6 Refs.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, *Distillation, *Multistage flash, *Multiple effect boiling, *Vertical tube foam evaporation, Single purpose, Dual purpose, Energy requirements, Fuel use performance ratio.

The fuel-use performance ratio is defined as the quantity of water produced, in kg, per 1000 kJ of the heat content of the fuel used for supplying thermal, mechanical and/or electrical energy to the desalination plant. The concept is used to evaluate the energy requirements of the major seawater conversion processes - RO, MSF, multiple effect boiling (as exemplified in the vertical tube foam evaporation process), vapor compression and hybrids of the thermal processes - for three types of plants: (a) single-purpose (water only), (b) dual-purpose (power/water) involving 'power loss' and (c) dual-purpose (power/water) utilizing waste heat. Only distillation systems based on waste heat can compete with the low energy requirements of reverse osmosis.
W84-00286

ENERGY ADVANTAGES OF REVERSE OSMOSIS IN SEAWATER DESALINATION,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
C. T. Sackinger.
In: Desalination, Vol 40, No 3, March 1982 (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), p 271-281, 8 Figs, 4 Refs.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Seawater desalination, Energy, Electric power costs, *Costs.

The very rapid increase in energy costs during the past three years is causing a change in the preferred process technology for seawater desalination. The phase changes, evaporation and condensation, required in the distillation processes make them more energy intensive than the ambient temperature liquid separation that occurs in the reverse osmosis (RO) process. The RO process and how to calculate its energy consumption are described. The RO process requires only 5-7 kWh/cu m of product water compared to 15-16 kWh/cu m required by the most efficient distillation process. The productivity of a large dual purpose electricity/RO water plant is compared to the productivity of a commercially purchased state-of-the-art dual purpose electric/distillation water plant that is currently under construction. The RO potable water productivity is about twice the distillate flow at the same fuel rate.
W84-00287

CONSIDERATIONS OF ENERGY CONSUMPTION IN DESALINATION BY REVERSE OSMOSIS,
UOP, Inc., San Diego, CA. Fluid Systems Div.
A. B. Riedinger, and C. E. Hickman.
In: Desalination, Vol 40, No 3, March 1982 (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), p 259-270, 10 Fig.

Descriptors: *Desalination, Energy consumption, *Reverse osmosis, Feedwater treatment, Osmotic pressure.

The primary factors affecting the energy consumption of a reverse osmosis (RO) plant are considered. These are the osmotic pressure of the feedwater, the feedwater temperature, the water recovery, and the relationship between the water flux and salt flux characteristics of the membrane. In addition, the required permeate quality may have several indirect effects on the energy consumption. Permeate quality standards may impose minimum operating pressures, limit the recovery, and/or require treatment with a full or partial 2nd. stage. As a general rule, the energy required increases with increasing feed salinity and increasing permeate quality. For any given recovery, a single stage system will require less energy than a partial two stage system. However, for a specified permeate quality, a partial two stage system can operate at a higher overall recovery and a lower energy consumption than a single stage system. Energy recovery systems can recover between 50 and 90% of the available energy consumption. Studies have shown that with an energy recovery system, the minimum energy consumption occurs at a first stage recovery of 30 to 35%. Currently, very few energy recovery systems are in use because of their high capital cost, but as energy recovery systems become more available and reliable, they will greatly increase the energy efficiency of RO plants.
W84-00288

DISTILLATION AND REVERSE OSMOSIS ENERGY CONSUMPTION AND COSTS,
Preece, Cardew and Rider, Brighton (England).
N. M. Wade, and M. R. Hornsby.
In: Desalination, Vol 40, No 3, March 1982 (Comprising the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980), p 245-257, 2 Tab, 4 Figs.

Descriptors: *Desalination, Desalination plants, Distillation, Reverse osmosis, Energy, Costs, *Electric power demand.

Energy requirements are compared of single and dual purpose multistage flash distillation with a seawater reverse osmosis (RO) plant. Energy consumptions are given both as heat and power consumptions for distillation and as power consumption for RO. To enable a true comparison to be made these inputs are referred back to the heat inputs from fuel needed at the boiler plant or appropriate thermal power plant. Energy recovery is also considered for reverse osmosis and it is shown that the energy input can be expected to decrease by some 35% for a typical example. Although the prime energy input needed for reverse osmosis is shown to be substantially lower than for dual purpose distillation, the overall costs taking account of capital charges, energy, replacements and other operating costs, are found to be in a band width of about 5% for plants in the range of 5000 to 15000 cu m/day. Reverse osmosis plant water costs are significantly less than distillation if membrane life increases from 3 years to 5 years, particularly with small plant capacities.
W84-00289

AN INTRODUCTORY SURVEY OF ENERGY ASPECTS IN DESALTING PROCESSES,
Aquila Univ. (Italy).
D. Barba.
In: Desalination, Vol 40, No 3, p 227-229 (Summary of the Round Table Conference on the Influence of Thermodynamic and Economic Aspects in Energy Consumption for Water Production during the 7th International Symposium on Fresh Water from the Sea, Amsterdam, September 1980).

Descriptors: *Desalination, Desalination plants, Electric power demand, Costs, *Energy.

A special conference was held dealing with relations between desalting processes and energy to obtain a state-of-the-art review comparing various desalting processes. Discussions are mainly oriented to demonstrate consumption of energy of evap-

oration vs. membrane processes stressing that objective methods of measurement do not exist.
W84-00290

3B. Water Yield Improvement

GEOPHYISCAL EXPLORATION SURVEYS FOR GROUND WATER IN THE SAN PEDRO BASIN, ARIZONA,
Arizona Univ., Tucson. Coll. of Earth Sciences.
J. S. Sumner, and P. F. Halvorson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110808, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, August 1983. 24 p, 2 Fig, 2 Tab, 40 Ref. OWRT A-108-ARIZ(1), 14-34-0001-1103.

Descriptors: Geology, *Gravity studies, Subsurface investigations, Model studies, *Arizona, *Geophysical exploration, *Groundwater, San Pedro basin.

To increase knowledge of the subsurface geology in the San Pedro Valley, Southeastern Arizona, several hundred additional gravity measurements were taken in the region. The new gravity values were supplemented by private data donated to this project and to the Arizona Gravity Data Base. The primary purpose of the gravity research was to obtain more information about the thickness and extent of the water-bearing alluvium in the San Pedro Basin. Two-dimensional cross-sectional models of the best gravity profiles were generated. Geologic information, especially in the way of formation density values, was added to the gravity models whenever possible. The gravity station density of the southern part of the study area (upper San Pedro Basin) was such that a three-dimensional subsurface model can be developed. Well data and a general knowledge of the geology in the San Pedro Valley were used to help constraint the variables involved in modeling the gravity data. It appears that a considerable resource of ground water exists in the San Pedro Basin in the area of this study. Approximately 50 x 10 super 6 acre-feet underlie the northern portion between Winkieman and Benson and 100 x 10 super 6 acre-feet south of Benson for a total of 150 x 10 super 6 acre feet. The gravity method has proven to be successful in outlining the concealed bedrock edges of the basin, made obscure by weathering and a soil veneer.
W84-00007

3C. Use Of Water Of Impaired Quality

OPTIMIZATION OF PRIMARY PRODUCTION BY THE HALOPHYTIC ALGA, DUNALIELLA SALINA, IN SALINE WATER,
New Mexico Water Resources Research Inst., Las Cruces.
R. Roubicek, and L. White-Hosford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113604, Price Codes: A04 in paper copy, A01 in microfiche. Technical Report No 166, April 1983. 53 p, 13 Fig, 10 Tab, 34 Ref. OWRT A-067-NMEX(1), 14-34-0001-2133.

Descriptors: *Algal growth, *Halophyte, Growth rate, *Biomass, *Production, Brackish water, Saline water, Respiration, Osmoregulation, Photosynthesis, *Dunaliella, *Metabolism, Algae.

The industrial cultivation of algal biomass is a very attractive project for both primary and secondary metabolite production. Solar energy conversion via algal cultivation results in yields which can be more than 100 times greater per acre than terrestrial crops. However, algal biomass production has not yet been shown to be economically feasible due to traditional technologies in which algae are grown in large shallow ponds. Because of the low depth of the ponds, an extremely large area is required to build a minimally economical production unit. Many other factors render this process difficult to control. An abundance of saline underground water can be found in arid or semi-arid areas with solar availability. The use of shallow ponds for algal biomass production in these areas enhances the evaporation rate of the water making salinity a limiting factor. For these reasons, the behavior of halophytic algae of the genus Dunaliella and the feasibility of employing submerged cultivation in a photo-bioreactor using brackish and saline media was investigated. Dunaliella salina produces large quantities of glycerol as a osmoregulative response to high concentrations of salts. Dunaliella bardawil, under the same condition produces high concentrations of B-carotene. In the first stage of experimentation the most productive isolates were selected and conditions of maintenance were established. The selected isolates were tested for growth in laboratory shaker experiments and finally laboratory pilot plant experiments were carried out in a 14 liter submerged culture.
W84-00138

ASSESSING BRACKISH WATER FOR GUAYULE RUBBER PRODUCTION,
Arizona State Univ., Tempe. Div. of Agriculture.
T. L. Righetti, and R. A. Backhaus.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113612, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Arizona, Tucson, September 1983. 18 p, 7 Fig, 2 Tab, 13 Ref. OWWR A-116-ARIZ(1), 14-34-0001-2103.

Descriptors: *Guayule, Hydroponics, Parthenium argentatum G., Plant greeding, Plant selection, Salinity solution culture, Water quality, *Brackish water, Rubber production, *Arizona, Tempe, *Plant tolerance.

A screening procedure for salt tolerance in guayule has been developed. Two small scale and one large-scale (100 liter tanks) solution culture screening trials have been completed. Producing 1,200 to 2,000 uniform transplants from germplasm varying in germination time and percentage is cumbersome, but the following procedure has been developed for routine use. Seeds are pregerminated in aerated distilled water then sprouted in flats of peat-vermiculite under an automated mist system. After three weeks seedlings are transplanted into individual containers and grown another three weeks before transplanting into solution culture tanks. Aeration is provided with a Gardner-Denver rotary blower. Salt stresses are gradually implemented over a two-week period. Plants are harvested after ten weeks. A portion of the experiment is not included in the destructive harvest so some seedlings showing striking salt resistance or sensitivity can be maintained for further study. Within strain variability makes it difficult to statistically detect differences among strains. It may be more useful to select tolerant individuals for inclusion in breeding programs than to identify resistant strains. Even with the variability encountered some strain difference are apparent. Guayule strain N396 has shown superior survival when stressed with magnesium chloride and appears to tolerate sodium chloride stress better than other strains. Differences are not due to differing uptake of Ca, K, Mg, or Na.
W84-00139

HUGE SEAWATER PLANT PERFORMS AS PLANNED,
S. L. Matheny.
Oil and Gas Journal, Vol 78, No 27, p 87-88, 92, July, 1980. 3 Fig.

Descriptors: *Seawater, *Desalination plants, Demineralization, Desalination apparatus, Water supply development, Industrial water, Water quality, Water treatment, *Saudi Arabia.

A seawater treatment plant designed to take in a volume of 19 million barrels per day is described. The treated water is employed in injection wells in the Ghawar oilfield, Saudi Arabia. The plant cost about $500 million to construct. The plant went onstream in June 1978. The intake side of the plant is sealed off by a rock wall basin. The seawater first passes through a bar screen which separates out solids larger than 1 inch in diameter. The drum screen, next in line, filters out all particles over 2 mm in diameter. One hundred lb/hr of hypochlorite solution is injected into the stream before it goes into the canal at a chlorine content of about 4 ppm. Supplemental chlorine is added as needed. The chlorinated water passes through four horizontal Baker sand filters. Each deaerator can handle 500,000 b/day at 1 atmosphere pressure. Each deaerating column has 16 trays. The system is designed to deliver injection water of a quality which will not plug the injection wells. (Baker-FRC)
W84-00291

3D. Conservation In Domestic and Municipal Use

IMPACT ON RESIDENTIAL WATER CONSUMPTION OF AN INCREASING RATE STRUCTURE,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 6C.
W84-00100

3E. Conservation In Industry

INDUSTRIAL WATER REUSE VERSUS NET WATER LOSS,
Delaware River Basin Commission, Trenton, NJ.
S. D. Selzer, and P. J. Webber.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111822, Price codes: A05 in paper copy, A01 in microfiche. Completion Report OWR/RU-83/2, U.S. Dept. of the Interior, Bur. Reclamation, Washington, DC, June 1983. 84 p, 4 Fig, 7 Tab, 12 Ref, 2 Append. OWRT C-00079-R(No 0493)(1).

Descriptors: *Water loss, *Consumptive use, *Water reuse, *Industrial water, *Cooling water, Cooling towers, *Delaware River, Evaporation, Heat exchangers, *Dry cooling, *Heat recovery, *Reuse factor, Petroleum industry, Chemical industry, Paper industry, Food industry, Primary metal industry.

Water use and other data of 13 Delaware River Basin industrial plants were examined to determine the impact of increased reuse of water upon consumptive use of water. The plants were of the petroleum, chemical, paper, food, and primary metal industries. The change over time, year 1971 to 1981, of the reuse factor (reuse/withdrawal) was compared to change in consumptive use per unit of product. The reuse factor was increased for 9 plants. The consumptive use per unit of product was decreased for 7, increased for 1, and remained constant for 1 of these plants. The reuse factor was not measurably changed for 4 plants. The consumptive use per unit of product was decreased for 2 and was increased for 2 of the 4 plants. For 86 plants in the Basin, including the 13 discussed above, the combined consumptive use was decreased from 1971 to 1981. Although there were limited quantitative data, none of the 86 appeared to have experienced a decrease in the reuse factor over the 1971-81 decade. Causes for increased reuse have included minimization of water and waste treatment and energy costs. Causes for decreased consumptive use have included increases in dry cooling and heat recovery.
W84-00042

3F. Conservation In Agriculture

THE EFFECT OF MOISTURE STRESS ON CORN PRODUCTION IN THE HIGH PLAINS,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis, and D. Smeal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113653, Price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Technical Report No 171, Las Cruces, June 1983.

73 p, 10 Fig, 26 Tab, 3 Ref, 4 Append. OWRT B-069-NMEX(1), 14-34-0001-0234.

Descriptors: *Corn, *Crop production, Computer model, *Moisture stress, Irrigation, High plains, Crop yield, Evapotranspiration, Simulation, Model studies, Soil moisture.

Evapotranspiration and yield were measured for selected deficit irrigation and nitrogen levels, and the data used to derive the water production function. Nitrogen stress limited yield but did not affect the water production function relationship. However, the water production functions did vary in their intercept between years. These differences may have been due to differences in yearly soil evaporation. The slope of the water production functions of the water use efficiency was the same over years. Corn growth was modeled using a physiologically based model. The model simulated biomass and grain yield under non-moisture stress conditions within 10% of the measured values, and over estimated production as moisture stress increased. Modifications to the model to include the effect of moisture stress on leaf size and the effect of hail damage on corn growth increased the model's predictability, but still the model over estimates corn growth under soil moisture stress conditions. The model did not do a satisfactory job of predicting corn growth when competition between plants was decreased due to the low planting density that occurred in 1982.
W84-00163

SOIL CRUSTING AFFECTS WATER CONSERVATION AND INFILTRATION,
Kansas Water Resources Research Inst., Manhattan.
D. M. Powell, and J. M. Steichen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113695, Price codes: A02 in paper copy, A01 in microfiche. Contribution No 232, March 1983. 24 p, 7 Fig, 8 Tab, 13 Ref, 1 Append. OWRT A-108-KAN(1), 14-34-0001-2118.

Descriptors: *Rainfall infiltration, *Infiltration rate, *Mathematical models, *Surface sealing, Tillage, *Crop residue, *Soil crusting, *Kansas, Model studies, *Water conservation.

An infiltration model is developed to include formation of a soil crust under transient conditions. A Soil-Crust Index has been defined and experimentally tested for two Kansas soils. The infiltration model utilizing the Soil-Crust Index was field tested on several tillage practices but for only one soil. The results of the laboratory experiments failed to indicate that the Soil-Crust Index can be applied across soil textures. Additional information is needed, particularly as pertains to high Soil-Crust Index values, before this can be adequately determined. The field experiments indicated that simulated infiltration trials may adequately predict infiltration for different tillage practices provided surface-depression storage can be properly estimated.
W84-00167

CAREFUL CROP PLANNING CUTS STRAIN ON IRRIGATION WATER SUPPLY.
New Zealand Journal of Agriculture, Vol 145, No 6, p 15-16, December, 1982.

Descriptors: *Irrigation efficiency, *Scheduling, Agronomy, Water conservation, *Water demand, Planning, Conservation, *New Zealand.

Careful crop planning can help match irrigation needs with scarce supplies during a drought such as was experienced recently in New Zealand. This is done by selecting crop types with regard to their watering demand pattern and by timing sowing dates so that peak water demands for different areas do not coincide. If a crop plan shows an overextension of water supplies, altering the proportions of crops and/or changing sowing dates can even the water demand. An example illustrates that barley, spring peas, and white clover all need irrigation in early December. Replacing some of these crops with autumn peas (irrigated in mid to late November), linseed (irrigated mid-October), or autumn wheat (irrigated early November) would overcome this problem. Altering sowing dates has little impact in autumn, but in spring a 1 month delay in sowing can postpone the critical growth stage about 1-3 weeks. During hot dry weather the water demand schedule is condensed. (Cassar-FRC)
W84-00170

TRICKLE IRRIGATION VS. NO-IRRIGATION OF FIVE HORTICULTURAL CROPS IN PENNSYLVANIA,
Agricultural Research Service, Shafter, CA. Cotton Research Station.
W. R. DeTar, D. F. Kibler, D. W. Grenoble, R. Daniels, and R. H. Cole.
Transactions of the ASAE, Vol 26, No 1, p 82-86, 1983. 1 Tab, 10 Ref.

Descriptors: *Trickle irrigation, *Crop yield, Irrigation programs, Potatoes, Strawberries, Irrigation, Water supply, Water conservation, Raspberries, Apples, Cantaloupes, *Pennsylvania.

Several irrigation experiments were set up in 1979, 1980, and 1981 on five crops, strawberries, raspberries, potatoes, apples, and cantaloupes, with irrigated vs. non-irrigated treatments being the main point of interest. The trickle irrigation system was found to be a very useful tool for this type of field study in that it provided excellent moisture control and permitted proper randomization and replication within relatively small land areas. Significant yield differences were found only in the 1980 potatoes and the 1980 cantaloupes. In 1980, non-irrigated Norchip potatoes yielded 35% less than irrigated potatoes. A drought in June of 1980 caused the non-irrigated cantaloupes to produce 15.5% less than the irrigated treatment. However, a drought in August of 1981 caused no significant reduction in cantaloupe yield, leading one to conclude that irrigation of cantaloupes is not needed during the 3 weeks just before harvesting. The use of single chambered perforated tubes in every other potato row did not reduce yields, in spite of an obvious lack of uniformity of water application. (Baker-FRC)
W84-00180

ESTIMATING LOSSES FROM A ROTATING-BOOM SPRINKLER,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
A. S. Dylla, and H. Shull.
Transactions of the ASAE, Vol 26, No 1, p 123-125, 1983. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Sprinkler irrigation, *Evaporation, Water loss, Irrigation practices, Irrigation, Wind drift, Wind, Mathematical equations, Estimating equations.

Evaporation and wind drift losses from a moderate sized sprinkler system operated in Minnesota were investigated to provide better information for designing and managing irrigation systems in a windy, humid and temperate climate. Spray evaporation and wind drift losses were determined from the operating system by measuring differences between the water pumped through the system and the water reaching vegetative and soil surfaces in the sprinkler pattern area. A grid array of sprinkler water collectors was used. Water loss amounts and climatic data for 31 sprinkler runs were used to calculate a multiple linear regression loss estimating equation. It was concluded that the difference between the metered volume of water pumped through an irrigation system and that reaching soil and crop surface, as calculated from grid-arrayed collector cans, was a reasonable estimate of the combined spray evaporation and wind drift losses. Although such losses are related to the evaporative conditions of the atmosphere during sprinkling, it is not prudent to fail to recognize that the losses are also related to the peculiar water discharge. For calculating the percent combined evaporation and wind drift losses from a large rotating-boom sprinkler system operating in a semi-humid temperate climate, the equation given is sufficiently accurate for irrigation planning and scheduling and determining gross water requirements. (Baker-FRC)
W84-00182

ENERGY AND WATER REQUIREMENTS FOR SUBIRRIGATION VS. SPRINKLER IRRIGATION,
Earlham School of Religion, Richmond, IN.
F. C. Massey, R. W. Skaggs, and R. E. Sneed.
Transactions of the ASAE, Vol 26, No 1, p 126-133, 1983. 7 Fig, 9 Tab, 22 Ref.

Descriptors: *Subsurface irrigation, *Sprinkler irrigation, *Energy, Model studies, Irrigation programs, Irrigation practices, Seepage, Water loss, *North Carolina.

Water and energy requirements of subirrigation and sprinkler irrigation systems for three sites in eastern North Carolina were determined. The specific objectives of the study were to obtain soil input data and design both subirrigation and sprinkler irrigations; to simulate the operation of the irrigation systems over several years of climatological record to evaluate the performance of each system; and to evaluate the amount of water and energy required, on the average, for comparable sprinkler irrigation and subirrigation systems in humid regions. It was concluded that subirrigation required more water than sprinkler irrigation for the cases considered. Sprinkler irrigation required 4 to 8 cm less water on the average than the subirrigation when seepage losses and efficiencies were taken into account. When a surface water supply was assumed, subirrigation required only about 9 and 6% of the energy required for the 340 and 690 kPa sprinkler irrigation systems, respectively. When a deep water supply was used, subirrigation offered a 20% savings in the amount of energy required for the 340 lPa system under sandy loam soil conditions. The climatic conditions had an effect on the volume of water pumped and therefore on the total energy requirements. Differences in energy requirements for the subirrigation and sprinkler irrigation systems at Jacksonville, Florida and Indianapolis, Indiana, were about the same as given in the study for North Carolina conditions. (Baker-FRC)
W84-00183

IRRIGATION UNIFORMITY EFFECT ON LAND AND WATER ALLOCATION,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
I. Seginer.
Transactions of the ASAE, Vol 26, No 1, p 116-122, 1983. 6 Fig, 6 Ref.

Descriptors: *Irrigation, *Water supply, Water conservation, Crop yield, *Water distribution, Mathematical studies, Mathematical equations, Water allocation.

The problem of allocating land and water to a single irrigated crop is treated, with emphasis on the effect that water distribution uniformity should have on the decisions to be taken. Eventually considerations of uniformity should be incorporated in more complex allocation problems. Analytical solutions are developed for simple production and distribution functions. Three general situations become apparent: (a) limiting water, when all water should be used for irrigation; (b) limiting land, when all available land should be irrigated; and (c) limiting crop, when it is not justified to irrigate the given crop. For any given production function, the optimal seasonal water application may vary widely, depending on the price system, the availability of land and water, and the uniformity of water application. The returns for improving the uniformity coefficient are affected strongly by the curvature of the production function, but only slightly by the relative availability of land and water. (Baker-FRC)
W84-00184

DRIP IRRIGATION APPLICATION EFFICIENCY AND SCHEDULES,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
I. P. Wu, and H. M. Gitlin.

Transactions of the ASAE, Vol 26, No 1, p 92-99, 1983. 9 Fig, 1 Tab, 10 Ref.

Descriptors: *Irrigation practices, *Application rates, Hydraulics, Irrigation, *Drip irrigation, Efficiency, Irrigation programs.

A drip irrigation system has a potential for a higher application efficiency than the other irrigation systems such as furrow and sprinkler. Drip irrigation application efficiency can be estimated for all types of emitter flow profiles caused by hydraulic design. A relationship was determined between drip irrigation application efficiency and percent of deficit for design criteria for 10% and 20% emitter flow variation. Drip irrigation application efficiency can be estimated for emitter flow variations stemming from both hydraulics and manufacturing. The irrigation time can be calculated based on the total water requirement, the allowable deficit, the actual total discharge, and the irrigation application efficiency. The emitter flow variation in a drip irrigation design or any nonuniformity of emitter flow will result in an extra amount of irrigation to meet the water requirement for the whole field. If any percent of deficit is allowed, the extra amount of irrigation will be reduced. A water saving of 10-30% can be made by allowing a 3-6% deficit in the irrigation scheduling. The allowable deficit, however, depends on the crop tolerance to soil moisture deficiency. The assumption that the total emitter flow variation is a normal distribution has not been verified using laboratory data or field measurements. However, the contribution of hydraulics to the total variation is only a small portion, while a larger portion is contributed by manufacturing variation which is normally distributed. Deficit irrigation increases water application efficiency and can achieve an application efficiency of 100%. (Baker-FRC)
W84-00192

DESIGN PROCEDURE OF SPRINKLING LATERALS: THE MATHEMATICAL BACKGROUND OF A COMPUTERIZED AID: COMMENTS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron.
Agricultural Water Management, Vol 5, No 4, p 375-377, December, 1982. 3 Ref.

Descriptors: *Design criteria, *Mathematical equations, *Sprinklers, Sprinkler irrigation, Sprinkling, Computers, Irrigation.

Methodology used in the procedure for sprinkling lateral design by Pleban and Amir in the above titled paper, published in Agriculture Water Management, Vol 3, p 269-278, 1981, is praised, but comments are presented on the equation used to describe the flow rate. The original authors express the flow rate through the sprinkler by a polynomial third degree, and had used a polynomial expression for the discharge-pressure head function of emitters. The current author would have preferred the use of an exponential expression. It was out of practical considerations only that the original authors decided against the use of an exponential expression and used instead the polynomial one. It is noted that without changing the design procedure either expression could be used where it is practically justified. (Baker-FRC)
W84-00349

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

OPTIMAL OPERATION OF A MULTIPLE RESERVOIR SYSTEM,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and H. A. Loaiciga.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111665, Price codes: A14 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, University of California, Davis, September 1983. 298 p, 27 Fig, 75 Tab, 86 Ref. OWRT-A-088-CAL(2).

Descriptors: *Reservoir operation, *Optimization, *Model studies, Energy, Streamflow, Multiobjective planning, *California, Central Valley Project, *Multiple reservoir systems.

A methodology to obtain optimal reservoir operation policies for a large-scale reservoir system is presented. The model maximizes the system annual energy generation while satisfying constraints imposed on the operation of the reservoir network. The model incorporates the stochasticity of river flows and keeps future operating schedules up-to-date with the actual realization of those random variables. It yields medium-term (one-year ahead) optimal release policies that allow the planning of activities within the current water year, with the possibility of updating preplanned activities to account for uncertain events that affect the state of the system. The solution approach is a sequential dynamic decomposition algorithm that keeps computational requirements and dimensionality problems at low levels. The model is applied to a nine-reservoir portion of the California Central Valley Project and the results are compared with those from conventional operation methods currently in use, showing that the use of the model can improve the levels of energy production (about 30% increase) while the optimal release policies meet satisfactorily all other functions of the reservoir system. Sensitivity analysis is conducted to assess the optimality of the solutions and several alternative formulations of the model are developed and tested, the results showing the robustness of the optimal policies to the choice of model. (Snyder-California)
W84-00026

PREDICTING DAILY IRRIGATION PROJECT DIVERSIONS,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
S. Kim, J. R. Busch, and K. H. Yoo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111855, Price codes: A05 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, October 1983. 72 p, 13 Fig, 3 Tab, 20 Ref, 3 Append. OWRT A-074-IDA(1), 14-34-0001-2114.

Descriptors: Irrigation systems, *Irrigation districts, Water management, *Irrigation practices, Water demand, *Diversions, Prediction, *Idaho.

The purpose of the research was to develop and apply methods for predicting daily irrigation diversions. Two types of models were developed to effectively predict diversions one day in advance and were applied to two large irrigation projects located in southeastern Idaho. The types of procedures developed and tested were (1) physical and (2) statistical procedures. In addition, variables related to predicting diversions were presented and their relationships described. The physical model developed was designed to accurately represent the physical processes of water conveyance and use in an irrigation system. Required inputs included crop consumptive use and irrigation efficiencies in conjunction with time variables such as irrigation interval, irrigation application time and traveling time in the system. Results from the physical model indicated that more data would be necessary for accurate predictions in addition to updating procedures to account for seasonal variations within the system and management. Statistical models were developed using multiple regression techniques. Required inputs included evapotranspiration, precipitation, weekly variation of water use, previous diversion, and dummy variables used to account for monthly and seasonal variations of soil moisture management. Predictions from the statistical model followed actual diversions quite closely for three irrigation seasons. It was concluded that the statistical models were superior to the physical modeling approach for predicting irrigation diversions.
W84-00045

A HEURISTIC SOLUTION PROCEDURE FOR A JOINT RESERVOIR CONTROL-CAPACITY EXPANSION PROBLEM,
National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
M. Sniedovich, and P. A. Nielsen.
Water Resources Research, Vol 19, No 1, p 15-20, February, 1983. 7 Tab, 6 Ref.

Descriptors: *Reservoir operation, *Water supply systems, Optimization, Planning, Stochastic process, *Heuristic solution, Procedure.

The reservoir control-capacity expansion problem is treated by first solving a modified stochastic problem, then using simple heuristic methods to transform the optimal stochastic capacity expansion policy into a deterministic policy. This procedure avoids separating the problem into two sections and does not rely on steady state conditions. Since an optimal solution cannot be guaranteed, a procedure for constructing an upper bound for the optimal solution is given. This upper bound is used to evaluate the performance of the deterministic solutions and to determine whether the heuristic solution is nearly optimal. A numerical example illustrates the method. (Cassar-FRC)
W84-00106

ASYMPTOTIC DISTRIBUTION OF THE MAXIMUM DEFICIT WITH CORRELATED, PARTIALLY REGULATED OUTFLOWS,
Geological Survey, Lakewood, CO. Water Resources Div.
B. M. Troutman.
Water Resources Research, Vol 19, No 1, p 104-108, February, 1983. 4 Fig, 14 Ref.

Descriptors: *Flow regulation, *Reservoir releases, Reservoir operation, Markov process, Mathematical studies.

The asymptotic distribution of the maximum accumulated deficit with partially regulated, Markov-dependent net outflows having a Bernoulli distribution is derived, and the distribution for independent, continuous outflows is presented. It is demonstrated that under partial regulation the maximum deficit behaves as log n, where n is the length of the series; this is to be contrasted with the n to the 1/2 power behavior exhibited by fully regulated outflows. Also, as would be expected, the presence of correlation tends to increase the magnitude and variability of the maximum deficit. (Author's abstract)
W84-00107

DAILY OPERATION OF A MULTIPURPOSE RESERVOIR SYSTEM,
Southern Illinois Univ. at Carbondale. Dept. of Geology.
H. Yazicigil, M. H. Houck, and G. H. Toebes.
Water Resources Research, Vol 19, No 1, p 1-13, February, 1983. 11 Fig, 4 Tab, 13 Ref.

Descriptors: *Reservoir operation, *Model studies, *Decision making, Reservoir releases, Multipurpose reservoirs, Green River Basin, *Kentucky.

The Green River Basin Operation Optimization Model (GRBOOM) was designed to aid reservoir operators in making decisions for daily, real-time operations and for long-term operating guidelines. The Green River Basin, Kentucky, consists of four flood control reservoirs; recreation and low-flow augmentation are secondary objectives. The linear program model tries to minimize the sum of all daily penalties over the operating horizon (usually 1-5 days). Constraints include reservoir mass balance, storage zone, control station mass balance, flow zone, and release rate constraints. Simulation of reservoir operation using historical data for April 29, 1970, and for the 87-day period December 26, 1969-March 10, 1970, produced model-recommended operations that were 25.7% and 45.8%, respectively, more efficient than actual operations. The model is flexible and easily modified to allow experimentation with new operating regulations or policies. Results are produced in graphical form, if desired. (Cassar-FRC)
W84-00109

IMPROVEMENTS TO THE TRANSITION DEFINITION FOR THE LLOYD MODEL OF DISCRETE STATE STORAGE WITH CORRELATED INFLOWS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. G. Doran.
Water Resources Research, Vol 19, No 1, p 69-76, February, 1983. 8 Fig, 30 Ref.

Descriptors: *Reservoir storage, *Storage, Model studies, Lloyd model.

The transition probability matrices which result from the Lloyd model of storage are very large, and when these matrices are constrained to be of manageable size, loss of accuracy in the performance of the model results. A description is given of an extension to a previous technique, the divided interval scheme, which makes possible the practical use of Markov chain analysis with given inflow distributions to provide comparatively accurate results in a probabilistic account of reservoir behavior. The extension is applied specifically to the Lloyd model of storage for single reservoirs, and the results of such analyses are obtained with modest computer storage requirements. (Author's abstract)
W84-00110

REAL-TIME RESERVOIR SYSTEM OPERATION,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
M. H. Houck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113661, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 151, September 1983. 42 p, 7 Fig, 2 Tab, 10 Ref. OWRT B-125-IND(2), 14-34-0001-1223.

Descriptors: *Reservoir operation, *Optimization, Flood routing, Streamflow forecasting, *Kentucky, Model studies, *Real-time operation, Goal programming, Objective function, Chance constrained programming, Green River Basin, Nonlinearity.

Several different optimization models developed by researchers at Purdue University for real-time, short term reservoir system operation are described. The models include: an optimization model constructed specifically for a multi-reservoir, multipurpose system in Kentucky; a goal programming model that requires less information than most other models yet yields equivalent or better results; a chance constrained model that explicitly considers errors in streamflow forecasts in the operating environment; and a balancing model that uses cumulative distribution functions to maintain a balance between storage, release, and any other characteristic of the operation. The description of each model and comparisons between models are brief but references to the relevant literature are provided.
W84-00164

POLDERS: AN ANCIENT APPROACH TO LAND RECLAMATION,
Rijkswaterstaat, The Hague (Netherlands).
A. Volker.
Nature and Resources, Vol 18, No 4, p 2-13, October-December, 1982. 6 Fig, 6 Ref.

Descriptors: *Polders, *Land reclamation, *Drainage, Agriculture, Developing countries, Deltas, Water management, Coastal engineering, Marshes, Hydraulic engineering, Netherlands, Japan, Tidal flats, Flood protection, History, Economic aspects, Irrigation, Risks.

Polders are a sophisticated form of land reclamation involving flood protection by embankment construction, water course diversion, or upstream flood control. Control of the water levels inside the polders produces land with high agricultural potential. Lands reclaimed by polders are level, often with heavy soils, and have a high water table. They may be formed along sea coasts, from coastal and inland marshes and lakes, in river valleys and by drying up to tidal inlets and lagoons. Some of the deepest polders are 6-10 m below mean sea level. Land subsidence from excessive groundwater abstraction is handled by polder construction. The deeper polders pose a risk to lives and property in case of unusually high water or embankment failure. Therefore, valuable and well-populated polder lands are designed for protection against a 10,000 year sea flood and a 1,000-3,000 year river flood. Warning systems, information programs, a backup line of defense, and drainage arrangements are also necessary. Drainage of polders should be accomplished by gravity if possible, using tidal variations, a lower river reach, or pumping. Polder-type retention basins were used for agriculture by the Egyptians 5000 years ago and by the Sumerians over 3000 years ago. The first Europeans to reclaim land by poldering were the Etruscans, 2500 years ago. In recent times the Netherland and Japan have been most active in polder construction, beginning independently in the late 16th century. Asia has the largest polder acreage, mainly in India and China. In Europe, coastal areas, lake and river deltas, and marshes have been reclaimed. Relatively few polders have been constructed in Africa. Total world polder area is on the order of 10-50 million ha. Future polder construction is expected to be concentrated in developing countries, especially near large cities. (Cassar-FRC)
W84-00169

PIPE DRAINAGE OF HEAVY SOILS: A FIELD EVALUATION,
Soil Conservation Service, Lincoln, NE.
P. N. Walker, and J. D. Wells.
Transactions of the ASAE, Vol 26, No 1, p 112-115, 122, 1983. 7 Tab, 5 Ref.

Descriptors: *Drainage, *Permeability coefficient, *Illinois, Subsurface drainage, Pipes, Irrigation.

Field effective hydraulic conductivities and drainable porosities were determined and drain spacings were recommended based on specified rates of water table fall. A group of 60 Illinois soils were selected for possible evaluation. Five were studied at sites where subsurface drain pipe systems had been installed previous to the study. Plots were irrigated to bring the water table to the soil surface. Irrigation was stopped, and then water table depth and drain flow measurements were made periodically until the water table midway between drains was at a depth of 300 mm. Drainable porosities, hydraulic conductivities, and recommended pipe drain spacings were computed. It was concluded that the average measured drainable porosities for Bonnie, Bryce, Darwin, Piopolis, and Wabash soils ranged from 0.0340 to 0.0483. The field effective hydraulic conductivities ranged from 19.0 to 63.2 mm/h. Only Bonnie had values with USDA published ranges; the other soils had higher measured values. The recommended drain spacings were: Bryce, 24.2 m; Bonnie, 13.9 m; Wabash, 12.8 m; Darwin, 10.8 m; and Piopolis, 13.1 m. (Baker-FRC)
W84-00191

4B. Groundwater Management

SINGLE LOCATION DOUBLET WELL TO REDUCE SALT-WATER ENCROACHMENT: PHASE I - NUMERICAL SIMULATION,
Texas Water Resources Inst., College Station.
D. L. Reddell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110873, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No TR127, September 1983. 43 p, 6 Fig, 89 Ref. OWRT A-051-TEX(1), 14-34-0001-2146.

Descriptors: *Well doublet, Groundwater, *Numerical models, *Saline water encroachment, Well construction, *Simulation, Model studies, Water wells.

C. E. Jacob received patents in 1965 for a single location well doublet that would produce fresh water overlying salt-water without upconing of the heavier salt-water and pollution of the fresh-water zone. No known evaluation of the concept or development of design criteria has been accomplished. In this study, a finite difference radial flow model was developed to determine groundwater velocities and salt concentration as a function of time and space. This model was verified and is available for evaluating design criteria for Jacob's single location well doublet. Initial runs with the model indicate that the concept has potential, particularly in aquifers with clay lenses in the salt-water zone. Additional runs with the model will be needed to fully establish the design criteria necessary for Jacob's single location well doublet.
W84-00014

AN EIGENVALUE NUMERICAL TECHNIQUE FOR SOLVING UNSTEADY LINEAR GROUNDWATER MODELS CONTINUOUSLY IN TIME,
Servicio Geologico de Obras Publicas, Madrid (Spain).
For primary bibliographic entry see Field 2F.
W84-00083

EFFECT OF PUMPED-WELL IRRIGATION AND DRAINAGE ON THE MELIORATION OF SALT-AFFECTED SOILS,
Academia Sinica, Nanjing (China). Nanjing Inst. of Soil Science.
Y. Wen-Rui, and W. Zun-Qin.
Soil Science, Vol 135, No 1, p 47-53, 1983. 2 Fig, 3 Tab, 4 Ref.

Descriptors: Soil properties, *Salinity, *Soil treatment, Drainage, Irrigation, *China, Groundwater, Groundwater management, *Saline soils.

In recent years benefits have been derived from well irrigation and drainage which were adopted for the improvement of salt affected soils in China. Well irrigation can simultaneously lower the groundwater level, leach salts downward from the soil, alleviate the harmful effects of flooding, and promote the salt-leaching effect of natural precipitation in areas where the groundwater is fresh or contains few minerals. Extraction and drainage of highly mineralized groundwater by wells can control the groundwater level and replenish the groundwater layer by irrigation with fresh water diverted from rivers in areas where the groundwater is highly mineralized. This will accelerate salt leaching from soil and prevent secondary salinization of the soil. However, ditch drainage cannot be replaced by well drainage, and usually a combination of the two should be adopted to improve soil quality. Three major patterns of well application for the improvement in soil quality in use in China are: a combination of well irrigation and well drainage in regions where the groundwater is fresh or contains only small amounts of minerals; a combination of deep and shallow wells in regions that have mineralized groundwater; and shallow well drainage in regions of highly mineralized groundwater. (Baker-FRC)
W84-00194

4C. Effects On Water Of Man's Non-Water Activities

IMPROVED METHODS AND GUIDELINES FOR MODELING STORMWATER RUNOFF FROM SURFACE COAL MINED LANDS,
Kentucky Water Resources Research Inst., Lexington.
M. E. Meadows, and G. E. Blandford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111731, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 147, September 1983. 141 p, 21 Fig, 18 Tab, 64 Ref. OWRT B-069-KY(1), 14-34-0001-0222.

Descriptors: *Stormwater runoff, *Strip mines, Mathematical models, *Hydrologic models, *Synthetic hydrology, *Small watersheds, *Model studies, Simulation, Curve number, Unit hydrographs,

Kinematic runoff, Green-ampt infiltration, Finite element, Modified Newton-Raphson iteration, Excess rainfall pattern.

The investigations, developments and guidelines for several hydrologic modeling strategies are presented. Investigations were conducted to determine appropriate event curve numbers for surface mined disturbed watersheds; and performance of four synthetic unit hydrograph models (SCS curvilinear, SCS single triangle, Williams and TVA double triangle) on 38 USDA experimental watersheds in 14 physiographic provences using in excess of 270 events. A second test using only the SCS curvilinear unit hydrograph on 11 small watersheds and 48 events was conducted to investigate the excess rainfall simulated with the curve number model. A procedure for developing a unit hydrograph using the time area method and two parameter gama distribution is presented for ungaged watersheds or watersheds undergoing land use changes. The development of a coupled explicit finite difference Green and Ampt infiltration-implicit finite element kinematic water model is presented. The deterministic overland flow model includes a variable width which is essential for the accurate modeling of the watershed geometry. Both impervious and pervious watershed simulations are presented for the deterministic overland flow model.
W84-00033

A DECISION MODEL TO PREDICT SEDIMENT YIELD FROM FOREST PRACTICES,
National Forests in North Carolina, Asheville.
R. G. Burns, and J. D. Hewlett.
Water Resources Bulletin, Vol 19, No 1, p 9-14, February, 1983. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Sediment yield, *Model studies, *Forest management, Mathematical equations, Estimating equations, Decision making, Erosion, Erosion control, Forestry, *Georgia.

Forest managers need to predict sediment yield to perennial streams following various forest land operations in order to choose among best management practices. The universal soil loss equation (USLE) is not directly applicable to forest operations due to the heterogeneous soil surface conditions left by harvesting, site preparation, and planting. A sediment hazard index is proposed, to be based on the amount of exposed mineral soil and its proximity to streams. The model offered includes rainfall erosivity, soil erodibility, and average land slope, together with the index W. A paired watershed experiment in the central Georgia Piedmont was used to estimate parameters in the model. The experimental basin, 80 acres, was clearcut, drum roller chopped twice, and planted by machine. The standard error of estimate of the sediment yield was computed to be about 50 lb/ac per sampling period for four months. Use of Williams' erosivity index reduced the standard error to 33 lb/ac. It is suggested that the equations presented predict conservatively high for the normal range of expected rainfalls, but probably low under extreme rainfall. (Baker-FRC)
W84-00099

IMPACTS OF SILVICULTURE ON FLATWOODS RUNOFF, WATER QUALITY, AND NUTRIENT BUDGETS,
Florida Univ., Gainesville. Dept. of Forest Hydrology.
H. Riekerk.
Water Resources Bulletin, Vol 19, No 1, p 73-79, February, 1983. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Water quality, *Runoff, *Forest management, Hydrology, Silviculture, Flatwoods, Coastal areas, *Florida, Rainfall-runoff relationships, Nutrients.

Information is given on hydrology, water quality, and nutrient budgets for the first three years of a study on forest watersheds isolated by roads in poorly drained flatwoods of Florida. After 12 months of baseline calibration the forest in one watershed was harvested and regenerated with minimum disturbance, in the second watershed with maximum disturbance from common practices, and in the third watershed left intact as a control. Water yields from the maximum treatments increased a significant 250%, while that from the minimum treatments increased 117% as compared to the control. Weed vegetation remaining after the minimum treatment continued significant water use. The water yield increases lasted only for one year. Water quality was reduced by both treatments, with the most effect immediately after the maximum disturbance. Absolute levels of suspended sediments, potassium, and calcium remained relatively low. The maximum treatment caused significant changes in net cation balances only for one year. The information demonstrated relatively little effect of silvicultural practices in flatwoods on water quality as compared to data from upland forests. Water yield increases may be manipulated by the degree of harvest and weed control practices. (Baker-FRC)
W84-00101

ASPEN CLEARCUTTING INCREASES SNOWMELT AND STORM FLOW PEAKS IN NORTH CENTRAL MINNESOTA,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
E. S. Verry, J. R. Lewis, and K. N. Brooks.
Water Resources Bulletin, Vol 19, No 1, p 59-67, February, 1983. 5 Fig, 3 Tab, 36 Ref.

Descriptors: *Clearcutting, *Flood control, *Forestry, Aspen, Logging, Forest management, Watersheds, *Minnesota, Snowmelt, Rainfall-runoff relationships, Runoff, Storms, Rainfall.

An 18-year paired watershed study of rainfall and snowmelt response to clearcutting the upland part of an upland-peatland watershed in north central Minnesota is described. During the first year of this study one-half of the watershed was clearcut resulting in a 31% increase in annual water yield, but a 35% reduction in the size of snowmelt peak discharge. The nine-year response of peak discharge, storm flow volume, and timing of peak discharge following clearcutting are reported. Both snowmelt and rainfall runoff events are evaluated. Storm flow volumes from rain during the first two years increased as much as 170% but declined to preharvest volumes in the third year. Snowmelt volumes did not change significantly. Snowmelt peak discharge occurred about four to five days earlier after clearcutting, but the timing of storm flow from rainfall was not changed. Snowmelt peaks remained above precut size for nine years after clearcutting on the area undergoing natural regeneration to aspen saplings. Partial cutting - up to about one-half of the watershed - reduced peak snowmelt discharge because melt was desynchronized in cleared and forested parts. Clearing more than 2.3 of the watershed caused snowmelt flood peak size to double during the years with snow packs in excess of seven inches of water that remained until a day when temperatures exceeded 60 degrees F. (Baker-FRC)
W84-00103

4D. Watershed Protection

SOIL EROSION CONTROL ON OWNER-OPERATED AND RENTED CROPLAND,
Missouri Univ.-Columbia. Dept. of Agricultural Economics.
D. E. Ervin.
Journal of Soil and Water Conservation, Vol 37, No 5, p 285-288, September/October, 1982. 3 Tab, 19 Ref.

Descriptors: *Erosion control, *Conservation, Farming, *Land management, Erosion, Management, Decision making, *Missouri, *Soil erosion.

Data from Monroe County, Missouri, are used to demonstrate that there is less erosion control on rented cropland than on cropland operated by the owner. Effective erosion control on rented cropland, therefore, will require special features in new conservation programs, such as differential cost-sharing provisions for tenants. The inclusion of a cost sharing program for erosion control in the original lease agreement appears to be an impo tant element. How to promote this type of lea should be an important area of study for state a federal soil conservation agencies. An importa first step would be to educate landlords and tena about the potential benefits of conservation pra tices an provsions that can be put into a lea Conservation tillage and contour farming would significant factors in alleviating the erosion pro lem. (Baker-FRC)
W84-00020

MODELING SURFACE AND SUBSURFAC STORMFLOW ON STEEPLY-SLOPING FO ESTED WATERSHEDS,
Kentucky Water Resources Research Inst., Le ington.
P. G. Sloan, I. D. Moore, G. B. Coltharp, and J. D. Eigel.
Available from the National Technical Informatic Service, Springfield, VA 22161 as PB84-11172 Price codes: A09 in paper copy, A01 in microfich Research Report No 142, July 1983. 182 p, 75 Fi 8 Tab, 90 Ref, 3 Append. OWRT A-085-KY(1 14-34-0001-1119(FY81), 14-34-0001-2119(FY82).

Descriptors: *Forest watershed, Forest hydrolog Mathematical models, Model testing, Subsurfac flow, Subsurface water, Runoff, *Surface flo Model studies, *Kentucky, Robinson Fores *Rainfall-runoff relationships, Macropore flo *Stormflow, Watershed models, Process model

A simple conceptual rainfall-runoff model, base on the variable source area concept, was deve oped for redicting runoff from small, steep-slope forested Appalachian watersheds. Tests of th model showed that the predicted and observe daily discharges were in good agreement. Th results demonstrated the ability of the model t simulate the 'flashy' hydrologic behavior of thes watersheds. Five subsurface flow models wer evaluated by application to existing data measure at Coweeta on a reconstructed homogenious fore soil. The five models were: Nieber's 2-D and 1-D finite element models, the kinematic wave equatio and two simple storage models developed by th authors, the Boussinesq and kinematic storag models. All five models performed reasonably we on this homogeneous soil. The coupled infiltratio model had a large effect on the simulation result The cost of running the computer models and th computer memory requirements increased as the complexity increased. Field soil-water and precipi tation measurements were made on a small te plot in Robinson Forest, in eastern Kentucky These data were used to calculate runoff durin four precipitation events and to test three of th subsurface flowmodels on a natural watershed The simple kinematic storage model performed th best. Flow from the test plot was dominated b macropore flow during storm events, and by flo through the soil matrix during baseflow or reces sion periods. No surface runoff was observed o the test plot during the period of field observa tions, except on saturated near-channel sourc areas.
W84-00032

CLIMATOLOGICAL WATERSHED CALIBRA TION,
Forest Research Inst., Kepong (Malaysia).
A. R. H. Nik, R. Lee, and J. D. Helvey.
Water Resources Bulletin, Vol 19, No 1, p 47-50 February, 1983. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Precipitation, *Streamflow, *Fores management, Water resources development, Wate supply, Water quality, Climate, Watersheds, Evap oration, *West Virginia, Appalachian Mountains Mountains.

The hypothesis that climatic data can be used t develop a watershed model so that streamflow changes following forest harvest can be deter mined was investigated. Variables which were measured included precipitation, daily maximum and minimum temperature, and concurrent relative humidity. Computed variables included humidity deficit, saturated vapor pressure, and ambient vapor pressure. The high degree of correlation

between annual precipitation and discharge suggests a linear relationship and implies similar watershed storages among hydrologic years. Thus annual discharge must be influenced more by seasonal factors such as precipitation and evaporative demand than by gross year to year differences in soil water storage. Moreover, whereas annual stream flow totals or averages are relatively steady, seasonal patterns of streamflow and the climatic variables of temperature and humidity deficit are obviously cyclic. This points directly to a deterministic relation between evaporation and streamflow and suggests the need for some adjustment to achieve functional synchronization of the seasonal cycles of precipitation and streamflow. It is concluded that climatological calibration appears to be a viable approach under special circumstances, such as when only one watershed is available for study. However, the paired watershed approach is expected to remain the preferred method for determining the effects of forest management on the water resource because of its simplicity and accuracy. (Baker-FRC)
W84-00095

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

INVESTIGATION OF SURFACE WATER FOR CONTAMINATION WITH PSEUDORABIES VIRUS IN RUNOFF FROM PSEUDORABIES QUARANTINED NEBRASKA SWINE PRODUCTION AREAS,
Nebraska Univ.-Lincoln. Dept. of Veterinary Science.
C. L. Kelling.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110774, Price codes: A02 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, September 1983. 10 p, 3 Tab, 24 Ref. OWRT A-071-NEB(1), 14-34-0001-2129.

Descriptors: *Animal diseases, *Viruses, Water pollution sources, Surface runoff, Waste disposal, Assay, Water analysis, Nebraska, *Pollutant identification, Molecular filtration, Pseudorabies virus.

The objective was to develop methods to concentrate water samples and quantitate virus and to apply the techniques to virological assay of storage ponds, lagoons, waste disposal sites and surface water runoff from swine production areas for contamination with pseudorabies virus. Molecular filtration has been used to concentrate pseudorabies virus (PRV; Herpevirus susis) from six liters of saline or water. Essentially all of the PRV added to the six liters of fluid was concentrated in 100 ml of filtration retentate. Inclusion of a cellulose acetate filter in the system effectively removed particulate matter without reducing the viral titer of the filtrate. The ability to remove particulate matter from water renders the system applicable to concentration of surface water runoff for assay for the presence of PRV. The capability to concentrate PRV from larger volumes of water will provide technology to assay runoff water from PRV quarantined swine production units for the presence of virus.
W84-00004

OLIGOCHAETES AS INDICATORS OF POLLUTION IN THE HUMBER ESTUARY, WITH SPECIAL REFERENCE TO TUBIFICOIDES BENEDENI,
Anglian Water Authority, Huntingdon (England). Lincolnshire River Div.
B. E. Barnett.
Environmental Pollution, Series A, Vol 30, No 4, p 277-291, 1983. 7 Fig, 1 Tab, 16 Ref.

Descriptors: *Water pollution effects, *Species diversity, *Oligochaetes, *Tubificids, *Bioindicators, *Distribution patterns, Industrial wastes, Indicators, Species composition, Domestic wastes, Coastal waters, Estuaries, Humber Estuary, *England.

Two intertidal surveys were conducted to examine the geographical and tidal distribution, abundance and numerical dominance of major oligochaete species in relation to the potential role of these organisms as indicators of pollution in the Humber Estuary, United Kingdom. Results showed that Tubifex costatus and Tubificoides benedeni were dominant species according to the Shannon-Weaver diversity index. Although data concerning oligochaete distribution and abundance must be interpreted with care, T. benedeni appears to be a valid indicator of pollution in the Humber. Two sites receiving considerable volumes of industrial and domestic effluents coincide with extreme dominance areas for T. benedeni and very low diversity values. T benedeni conducts its entire life cycle in the relative safety of the subsediment and exhibits a high tolerance for anoxia. These qualities make this tubificid oligochaete a genuine pollution indicator in the more saline reaches of estuaries and coastal habitats. (Geiger-FRC)
W84-00025

CANDIDA ALBICANS AS AN ALTERNATIVE SANITARY INDICATOR ORGANISM FOR WATERS CONTAINING ACID MINE DRAINAGE,
West Virginia Univ., Morgantown. Water Research Inst.
D. A. DePasquale, C. B. Law, and G. K. Bissonnette.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111814, Price codes: A03 in paper copy, A01 in microfiche. Water Research Institute Completion Report, 1983. 32 p, 7 Fig, 7 Tab, 40 Ref. OWRT A-047-WV(1), 14-34-0001-2152.

Descriptors: *Acid mine drainage, *Bioindicators, Indicators, Sanitary wastewater, *Survival, Water quality, *Yeasts, Bacteria, Coliforms, Domestic wastes, Enteric bacteria, Feces, Microorganisms, Mine drainage, Pathogens, Pollutant identification, Sewage bacteria, Streptococcus, Urine, Water pollution, Water pollution effects.

Microbiological studies were conducted to assess the potential of using Candida albicans as a sanitary-indicator organism in streams impacted by acid mine drainage (AMD) and organic wastes. C. albicans was detected at low densities in AMD, particularly when compared to the occurrence of traditional indicator bacteria. The relatively lower density of C. albicans in AMD was a reflection of its likewise low incidence in raw sewage. Pure-culture survival studies indicated that C. albicans is extremely resistant to the adverse effects of AMD as demonstrated by prolonged persistence of at least three days. In addition to its extended survival, C. albicans incurred minimal sublethal injury from AMD stress. Exposure of traditional indicator bacteria to identical conditions resulted in significant sublethal injury. The failure of standard microbiological procedures to detect AMD-damaged bacteria compromises the accuracy of assessing the public health safety of these waters. On the other hand, the marked resistance of C. albicans to injury lends support to its use as an alternative sanitary-indicator organism in streams containing acid mine drainage (AMD).
W84-00041

SODIUM HEXAMETAPHOSPHATE AS AN AID IN BENTHIC SAMPLE SORTING,
Central Electricity Generating Board, Southampton (England). Marine Biological Lab.
R. N. Bamber.
Marine Environmental Research, Vol 7, No 4, p 251-255, 1982. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Sampling, *Benthic environment, *Sedimentation, Sediments, Sodium hexametaphosphate, Sieving, Muds, Clays, Silts, Benthic fauna, Aquatic animals, Benthos, Fauna, *Pollutant identification, River Medway, England.

Since sieving problems had been experienced with fine estuarine muds occasionally exposed to erratic oil spillage in the River Medway, experimental analysis was undertaken to determine the efficacy of the addition of sodium hexametaphosphate to the initial fixative preservative for benthic samples. The presence of 1.24 g/liter sodium hexametaphosphate in the fixative solution was seen to significantly aid the disaggregation of fine sediment and thereby increase the efficiency of sieving benthic samples by some 23%. Concentrations greater than 1.24 g/liter do not significantly improve upon this performance. Observation of animal specimens from the samples subsequent to sieving demonstrated no inhibition of staining or fixation, and since the function of Rose Bengal staining is not critically dependent upon the precise color, proposed spectrophotometric analysis of the effect of the hexametaphosphate on the color of the stain was unnecessary. Foraminiferan shells were common in the samples and showed no evidence of degradation. The proportion of material passing through the sieve during the limited sieving time of the experiment when compared with the particle size structure of the inorganic sediment suggests that for these sediments at least, no extra treatment such as freezing is needed to further enhance the efficiency of sample sorting. Up to 90% of the treated samples passed the sieve, compared to an inorganic fraction of less than 0.5 mm of 96%. (Baker-FRC)
W84-00140

APPLICABILITY OF CERTAIN COMMON BIOINDICATION METHODS TO EVALUATION OF WATER QUALITY IN THE LITTORAL ZONE OF THE KREMENCHUG RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Yu. V. Pligin, and L. A. Zhuravleva.
Hydrobiological Journal, Vol 18, No 2, p 30-34, 1982. 2 Tab, 16 Ref.

Descriptors: *Eutrophication, *Reservoirs, *Bioindicators, Kremenchug reservoir, Water quality, Littoral zone, Benthos, Invertebrates, *USSR.

The eutrophication-induced changes in water quality in the littoral zone of the Kremenchug Reservoir were studied by means of bioindicator methods based on benthic invertebrates and hydrochemical indices. Macrozoobenthos and water were sampled for chemical analysis in five main shallow areas of the reservoir. Analyses were made of 360 quantitative samples of macrozoobenthos, collected in years with very hydrometeorological conditions. Six bioindicator procedures were evaluated, of which the systems of Goodnight and Whitley, King and Ball proved most applicable. The methods of Parele and Pantle and Bucca were less suitable, and those of Balushkina and Woodiwiss failed to work in this context. If macrozoobenthos analysis is to be used for water quality estimation, several procedures that would take into account as many species of invertebrates as possible should be jointly employed. (Baker-FRC)
W84-00146

TRACE ANALYSIS OF SULFAMETHAZINE IN ANIMAL FEED, HUMAN URINE, AND WASTEWATER BY ELECTRON CAPTURE GAS CHROMATOGRAPHY,
National Center for Toxicological Research, Jefferson, AR.
C. L. Holder, H. C. Thompson, Jr., and M. C. Bowman.
Journal of Chromatographic Sciences, Vol 19, No 12, p 625-633, December, 1981. 8 Fig, 5 Tab, 17 Ref.

Descriptors: *Drugs, *Wastewater analysis, Sulfamethazine, Chemical analysis, Chromatography, Gas Chromatography, Trace levels, Pollutant identification, Feeds.

An electron capture gas chromatography method was developed for the determination of sulfamethazine, an antibacterial additive for animal feed, in wastewater at levels of 10 ppb. This toxic substance has the formula 4-amino-N-(4,6-dimethyl-2-pyrimidinyl) benzenesulfonamide. After cleanup by dichloromethane extraction, the samples were evaporated to dryness, methylated with diazomethane, acetylated with trifluoroacetic anhydride at the primary amine function, cleaned up on silica

gel, and assayed with electron capture gas chromatography. The compound was extremely stable in water. After 16 days storage at ambient temperature, solutions of 50 ppm and 500 ppm sulfamethazine yielded recoveries of 50 ppm and 496 ppm, respectively. (Cassar-FRC)
W84-00307

DETERMINATION OF TRACE AMOUNTS OF CHROMIUM (VI) IN PRESENCE OF SULFITE ION IN WASTEWATERS OF SURFACE TREATMENT (DETERMINATION DES TRACES DE CHROME (VI) EN PRESENCE DE SULFITE DANS LES EAUX RESIDUAIRES DE TRAITEMENT DE SURFACE),
Institut National de la Sante et de la Recherche Medicale, Paris (France).
P. Bourbon, J. Alary, J. -C. Lepert, and C. Balsa.
Analusis, Vol 9, No 3, p 110-112, 1981. 2 Fig, 6 Ref.

Descriptors: *Chromium, *Measurement techniques, *Trace levels, Heavy metals, Wastewater analysis.

Trace amounts of chromium (VI) cannot be determined in the presence of sulfite in wastewaters from surface treatment using the common techniques of spectrophotometry with diphenylcarbazide or atomic absorption after extraction with MIBK. A method of determination using pulse polarography is proposed. This method yields satisfactory results even in the presence of several metallic ions. Copper interferes with the method when its concentration exceeds 0.4 milligrams per liter and must be eliminated by precipitation at a pH of 9.5 to 10. The sensitivity of this method (20 micrograms of chromium (VI) per liter) is of the same order of magnitude as that achieved using the spectrophotometric method with diphenylcarbazide. In the absence of copper, the proposed method can also be used to determine the concentrations of some metallic ions, including cobalt, nickel, cadmium, and zinc, in the same sample. (Carroll-FRC)
W84-00308

IS ATP A SUITABLE BIOMASS PARAMETER FOR ACTIVATED SLUDGE. PART 1: THEORETICAL PRINCIPLES AND STATEMENT OF THE PROBLEM (IST ATP EIN GEEIGNETER BIOMASSE-PARAMETER FUR BELEBTE SCHLAMME. 1. MITTEILUNG: THEORETISCHE GRUNDLAGEN UND PROBLEMSTELLUNG),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
E. Thomanetz, A. Sperandio, and D. Bardtke.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 2, p 96-101, 1982. 3 Fig, 24 Ref.

Descriptors: *Activated sludge process, *Adenosine triphosphate, *Metabolism, Activated sludge, Bacteria, Biomass, Microbiology, Bacterial analysis.

Methods of activated sludge biomass analysis are discussed. Since live bacteria cannot be quantified, the number of live cells, or the DNA content correlatable with it, would appear to be a suitable biomass parameter for viable numbers in activated sludges. However, a clear distinction must be made between viable numbers in sludges and the metabolic activity of such sludges. The essential biochemical properties and the possible reactions of ATP (adenosine triphosphate) are described. It is shown that, while ATP is clearly not suitable as a parameter for viable numbers of bacteria in activated sludges, it may conceivably be suitable--though possibly with certain reservations--as a parameter for the metabolic activity of these sludges. (Carroll-FRC)
W84-00323

DETERMINATION OF TRACES OF SODIUM ALKYLBENZENESULPHONATE BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY. APPLICATION TO WATER,
Government Industrial Research Inst., Osaka (Japan).
T. Saito, K. Higashi, and K. Hagiwara.
Fresenius Zeitschrift Analytische Chemie, Vol 313, No 1, p 21-23, 1982. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Chromatography, *Water analysis, *Alkylbenzenesulfonate, Ion exchange, Surfactants, High pressure liquid chromatography, Detergents.

High-performance liquid chromatography has been developed for the analysis of traces of alkylbenzenesulfonate in water. The method consists in the first stage of ion-exchange separation of dodecylbenzenesulfonate in water, and in the second stage, their determination by HPLC. The following conditions were employed: Shimadzu ZORBAX SIL Column (5 micrometers, 4.6 mm i.d. x 150 mm) as stationary phase, 0.2% ammonia-ethanol (v/v) as mobile phase, UV detector at 225 mm, injection volume 12 microliters. The chromatograms of alkylbenzenesulfonate (ABS) were simple and sharp, with a detection limit of 0.02 micrograms in 12 microliters of ethanol. Calibration curves of ABS were linear in a concentration range of 0.03 to 0.3 micrograms in 12 microliters of ethanol. In the case of linear sodium dodecylbenzenesulfonate positive errors of 1-4% were caused by nonionic surfactants or lauryl sulfate (6 fold excess); 10-50% positive errors were caused by 2-6 fold excess of household detergents. Standard water samples containing ABS were treated with a weak base anion-exchange resin; the adsorbed ABS were eluted and then determined either by HPLC or by the methylene blue spectrophotometric method. Recoveries of ABS in water were about 92-107% by HPLC. (Baker-FRC)
W84-00329

SIMULTANEOUS DETERMINATION OF HEAVY METALS IN WATERS BY INDUCTIVELY-COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY AFTER EXTRACTION INTO DIISOBUTYL KETONE,
National Research Inst. for Pollution and Resources, Ibarkai (Japan).
A. Miyazaki, A. Kimura, K. Bansho, and Y. Umezaki.
Analytical Chimica Acta, Vol 144, p 213-221, 1982. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Pollutant identification, *Heavy metals, *Spectrophotometry, *Separation techniques, *Seawater, Chelating agents, Metal complexes, Cadmium, Lead, Zinc, Nickel, Copper, Iron, Molybdenum, Vanadium, Rivers, Water analysis, Metals.

The simultaneous determination of cadmium, lead, zinc, iron, copper, nickel, molybdenum and vanadium in river and sea water by inductively-coupled plasma atomic emission spectrometry was investigated. Diisobutyl ketone (DIBK) was used as solvent due to its low aqueous solubility and ease of introduction into the inductively-coupled plasma. The optimum observation height for the DIBK extract proved higher than that for an aqueous solution. Ammonium pyrrolidinedithiocarbamate (APDC) was used as chelating reagent at pH 2.4. The metals could be determined in samples at the microgram/liter level with detection limits ranging from 0.022 for cadmium to 0.60 for lead. The procedure should be applicable to other elements which form complexes with APDC. (Geiger-FRC)
W84-00334

TRACE METAL DETERMINATIONS IN ESTUARINE WATERS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY AFTER EXTRACTION OF DITHIOCARBAMATE COMPLEXES INTO FREON,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
L. G. Danielsson, B. Magnusson, S. Westerlund, and K. Zhang.
Analytica Chimica Acta, Vol 144, p 183-188, 1982. 3 Tab, 7 Ref.

Descriptors: *Heavy metals, *Pollutant identification, *Atomic absorption spectrophotometry, Salinity, Estuaries, Lead, Cadmium, Iron, Nickel, Zinc, Copper, Separation techniques.

The determination of cadmium, copper, iron, lead, nickel and zinc in estuarine waters by electrothermal atomic absorption spectrometry after extraction of dithiocarbamate complexes into freon is described. Samples of water are treated with 65% nitric acid and the dithiocarbamate complexes are extracted into Freon-TF and then back-extracted into dilute nitric acid solution. Portions of the back extracts are injected into a graphite furnace. A solution of mixed acetate buffer-complexing agent is used to eliminate the effect of high iron concentrations on the extraction procedure. The present method allows complete separation from the matrix irrespective of salinity and can be used throughout the full salinity range of an estuary. (Geiger-FRC)
W84-00347

5B. Sources Of Pollution

GROUNDWATER MONITORING AT A SEPTAGE LAGOON FACILITY,
Connecticut Univ., Storrs. Dept. of Agricultural Engineering.
J. Kolega, B. Morton, and H. Luce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110758, Price codes: A02, in paper copy, A01 in microfiche. Institute of Water Resources Completion Report, September 1983. 14 p, 2 Fig, 3 Tab, 13 Ref. OWRT A-090-CONN(1), 14-34-0001-2107.

Descriptors: *Groundwater pollution, *Lagoons, Leachates, Septic sludge, Septic wastewater, Connecticut, Monitoring, Path of pollutants, Waste disposal.

A groundwater monitorng network was installed at a newly constructed earthen septage (septic tank pumpings) treatment and disposal facility at Coventry, CT to study the movement of chloride, nitrogen, trace metals, and hydrocarbons from the septage lagoons and their effect on groundwater quality. The facility was situated in a glacial outwash deltaic kame located adjacent to a floodplain wetland abutting the Willimantic River. The soil at the site was a glacial-fluvial deposit of sand typical of many river valley sections in southern New England. Groundwater elevations at the monitoring wells were measured prior to water sample collection along with the redox potential, salinity and the specific conductance. Sealing from the biomat formation at the septage-soil interface of the primary lagoon bottom did not occur nor did complete nitrification take place. Of the trace metals, cadmium, chromium, and lead were observed beneath the primary lagoon at concentrations which were above the adverse effect level for drinking water in the United States. Certain organohalides exceeded the recommended limits to protect human health.
W84-00002

STUDY OF MICROBIAL INACTIVATION IN THE MARINE ENVIRONMENT,
Malaga Univ. (Spain). Dept. of Microbiology.
J. J. Borrego, F. Arrabal, A. de Vicente, L. F. Gomez, and P. Romero.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 297-302, March, 1983. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Marine environment, *Bacteria, *Outfalls, *Wastewater disposal, Water pollution sources, Salmonella, Seawater, Escherichia coli, Pollution indicators, Monitoring, Spain, Aladino outfall, Bioindicators.

Microbial inactivation in the marine environment occurs by two different processes - physical dilution by diffusion, or a process of biological inactivation. Microbial inactivation was studied at the Aladino outfall, located off Carihuela beach, Spain, which discharges about 1,000 m from the coast. It consists of an 800 ml drainage pipe without terminal diffusors. The depth of discharge is about 19 m, and it is classified as a deep outfall because its

discharge forms a mixing layer of less than the total depth of the seawater. It has an irregular flow, depending on the time of day, with a maximum at 3 pm of 15 liters/second. The minimum is in the early morning. Data collected at the outfall show that most bacterial species underwent an initial dilution of over 90%. Salmonella-Shigella loses its viability most rapidly, perhaps because of poor adaptive capacity. However, the overall degrees of inactivation achieved, in descending order, are total coliform, fecal coliform, Salmonella-Shigella, coliphage, and fecal streptococci. Using Escherichia coli-specific bacteriophage as a pollution indicator is an attractive consideration, but more study is needed. (Baker-FRC)
W84-00016

DEGRADATION OF ATRAZINE IN ESTUARINE WATER/SEDIMENT SYSTEMS AND SOILS,
Salisbury State Coll., MD.
T. W. Jones, W. M. Kemp, J. C. Stevenson, and J. C. Means.
Journal of Environmental Quality, Vol 11, No 4, p 632-638, October-December, 1982. 5 Fig, 3 Tab, 28 Ref.

Descriptors: *Herbicides, *Sediment, *Degradation, *Fate of Pollutants, *Atrazine, Pesticides, Estuaries, Agricultural soils, Soils, Chesapeake Bay, *Maryland.

The fate of atrazine (2-chloro-4-ethylamino-6-isopropyl-amino-s-triazine) was studied in two estuarine water/sediment microsoms, using water from a protected Chesapeake Bay site and from an open bay site, and in two agricultural soil systems (sandy loam and silty loam). Experiments were done under both aerobic and anaerobic conditions. Half-lives for atrazine were: water, 3-12 days (faster in open water samples than in protected site samples); sediments, 15 and 20 days; and soils, 330 and 285 days. These half-lives were based on the assumption that the ratio of atrazine and metabolites in the nonextractable portion was the same as in the extractable portion. Low oxygen conditions had littleeffect on the rate of atrazine degradation. The major short-term metabolite of estuarine and soil systems was hdroxyatrazine (2-hydroxy-4-ethylamino-6-isopropylamine-s-triazine). (Cassar-FRC)
W84-00018

FOOD CHAIN ENRICHMENT OF ORGANOCHLORINE COMPOUNDS AND MERCURY IN CLEAN AND POLLUTED LAKES OF FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
J. Paasivirta, J. Sarkka, K. Surma-Aho, T. Humppi, and T. Kuokkanen.
Chemosphere, Vol 12, No 2, p 239-252, 1983. 3 Fig, 9 Tab, 14 Ref.

Descriptors: *Food chains, Enrichment, *Lakes, *Finland, Fish, *Mercury, *Organochlorines, Pulp and paper industry, *Pulp wastes, Chlorinated hydrocarbons, Phenols.

A new sampling and analysis program was constructed for determining contents of mercury and chlorinated hydrocarbons and chlorinated phenols in different trophic levels of lakes in central Finland. The lakes under study are polluted by pulp mill and urban wastes. They contain pulp chlorine bleaching residues, mercury, methyl mercury, and organochlorine compounds in sediment, plankton, roach and pike. A 30-fold increase in mercury in bottom sediments has resulted from chlorine bleaching agents dumped in the lakes. This was not reflected in mercury levels in fish, which were highest at one natural condition (humic) lake and rather high also in semipolluted lake Paijanne. Mercury in fish was mostly methylated, but not completely, and its time trends could be estimated. Chloroform showed no bio-accumulation in fish. Carbon tetrachloride, tetrachloroethylene and chlorinated cymenes significantly bioaccumulated in fish. Levels of chlorophenols from bleaching had strongly decreased, but pentachlorophenol and 2,3,4,6-tetrachlorophenol levels remained related to earlier results. The present results show that although sediment seems to serve for storage of certain persistent biocides, the contents in bottom sediments do not directly reflect the contents in biota. (Baker-FRC)
W84-00023

THE EVALUATION OF METALS AND OTHER SUBSTANCES RELEASED INTO COAL MINE ACCRUAL WATERS ON THE WASATCH PLATEAU COAL FIELD, UTAH,
Utah Water Research Lab., Logan.
A. J. Seierstad, V. D. Adams, V. A. Lamarra, N. J. Hoefs, and R. E. Hinchee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111681, Price codes: A08 in paper copy, A01 in microfiche. Water Quality Series UWRL/Q-83/09, August 1983. 156 p, 30 Fig, 46 Tab, 68 Ref, 1 Append. OWRT B-210-UTAH(2), 14-34-0001-1273.

Descriptors: Coal, Coal mining, *Coal mines, *Leachates, Boron, Strontium, Water pollution control, Iron, *Acid mine drainage, Alkalinity, Mercury, Suspended solids, Grease, Hardness, Filtered wastewater, *Utah, Wasatch Plateau, *Metals.

In the face of probable coal mining expansion on the Wasatch Plateau of Central Utah, threats to drinking water safety and healthy aquatic environments were examined by reviewing reports submitted by mine operators as required by the National Pollution Discharge Elimination System, measuring pollutant concentrations in mine accrual waters before and after treatment, and analyzing experimental leachates obtained by upward flow of waters (prepared to match average natural conditions) through crushed coal in laboratory columns. The reports, mine accrual waters, and leachates covered six mines, four of which continually discharged water, and two of which were collecting water internally. One sump is being used for drinking water supply. Sampling continued from April 1981 through May 1982. Constituents measured and compared with water quality criteria for drinking, irrigating, stock watering, and aquatic resources included pH, suspended solids, metals, hardness, alkalinity, and silica. Generally, the waters did not exceed toxicity criteria, and concentrations leached from crushed coal samples provided a reasonable guide to concentrations measured in the accrual waters. Boron concentrations were occasionally high enough to affect sensitive crops. Mercury seldom exceeded standards but was generally close enough to deserve special monitoring and analysis for possible environmental effects. Acidity and iron were not a problem, but total suspended solids as well as oil and grease often were. The existing treatment by gravel filtration ponds and grease skimming devices was not very effective. Overall, the results did not find a significant pollution problem, identified potential hazards, and provided more cost effective pollution control information.
W84-00028

EVALUATION OF THE POTENTIAL FOR GROUNDWATER TRANSPORT OF MUTAGENIC COMPOUNDS RELEASED BY SPENT OIL SHALE,
Utah Water Research Lab., Logan.
R. E. Hinchee, V. D. Adams, J. G. Curtis, and A. J. Seierstad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111699, Price codes: A07 in paper copy, A01 in microfiche. Water Quality Series UWRL/Q-83/06, July 1983. 127 p, 23 Fig, 22 Tab, 150 Ref, 2 Append. OWRT B-210-UTAH(1), 14-34-0001-1273.

Descriptors: *Carcinogens, *Bioassay, Coal, *Oil shale, *Leachates, Water pollution sources, Groundwater pollution, Organic carbon, *Mutagenic compounds, *Utah, Wasatch Plateau, Anvil Points, *Retort processes.

The potential mutagenicity of aqueous leachates from coal, raw oil shale, and the spent shale resulting from two processes was tested. Specifically, an Ames salmonella microsomal bioassay was used to test for chemical mutagenicity. Spent oil shales from the Paraho and TOSCO II processes, a raw shale from Anvil Points, and a composite coal sample from Wasatch plateau were extracted with double deionized water and organic solvents. Of the tests, only organic solvent extraction of the TOSCO spent shale resulted in a mutagenic response. The lack of mutagenic response to organic extracts of Paraho spent shale was unexpected and probably due to high temperatures at which the shale had been retorted. By using a TOSCO spent shale leachate and an organically extracted mutagen, a partition relationship was developed between the spent shale and leachate water. A discovered high affinity of the mutagen for spent shale was believed to minimize amounts getting into the leachate. Consequently, it was estimated that the mutagenicity of spent shale leachate will be low (in the range of that of chlorinated wastewater). However, the large volumes of water required to complete the leaching of the mutagens from the pile are likely to create a chronic long-term problem.
W84-00029

EFFECTS OF CADMIUM ON STREAMS AND IRRIGATED AGRICULTURE IN THE PRESENCE AND ABSENCE OF OIL SHALE LEACHATE,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5C.
W84-00030

HERBICIDES IN RUNOFF FROM AGRICULTURAL WATERSHEDS IN A HIGH-WINTER-RAINFALL ZONE,
Oregon State Univ., Corvallis. Dept. of Soil Science.
J. S. Hickman, M. E. Harward, and M. L. Montgomery.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111772, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-86, Oregon State Univ., Corvallis, September 1983. 107 p, 19 Fig, 8 Tab, 95 Ref, 1 Append. OWRT B-075-ORE(1), 14-34-0001-0276.

Descriptors: *Herbicides, *Agricultural runoff, *Diclofop-methyl, *Diclofop, Hydrolysis, Chemical degradation, Leaching, *Trifluralin, Subsurface drainage, Stream pollution, Soil properties, *Agricultural watersheds, Path of pollutants, *Oregon, Williamette Valley.

Runoff losses were quantified for two herbicides from fall-planted agricultural watersheds in the Williamette Valley, Oregon. Factors and processes influencing herbicide transport were indentified. Diclofop runoff losses were measured following a January application (1.12 kg/ha) of diclofop-methyl. Diclofop-methyl rapidly hydrolyzed to diclofop ($t1/2<1$ day), while degradation beyond the diclofop molecule was much slower ($t1/2=42$ days). Runoff losses were 7.1 and 3.9% of the applied herbicide in 1980 and 0.7 and $<0.1\%$ in 1981 at a 6.0 ha and 1.4 ha (subsurface drained) watershed, respectively. The maximum diclofop concentrations were 370 and 790 mg/m super 3 at the two watersheds, respectively. More than 80% of the diclofop loss was partitioned into the aqueous phase of runoff. Runoff losses of trifluralin following a 0.84 kg/ha October 1979 application were 0.9 and $<0.1\%$ and maximum concentrations were 216 and 9.5 mg/m super 3 at the 6.0 and 1.4 ha watersheds, respectively. Lowere runoff losses of both herbicides at the 1.4 watershed were attributed to the effectiveness of the subsurface drainage system (a potential management practice) in reducing antecedent soil moisture. Herbicide losses in the subsurface drainage effluent accounted for 1.2 and $<0.1\%$ of the applied diclofop in 1980 and 1981, respectively, and $<0.1\%$ of the applied trifluralin. Major factors affecting herbicide runoff losses were (1) proximity of the first runoff event to the application date, (2) soil moisture status before and during storm events, (3) magnitude of the precipitation events, and (4) formation of a soil crust.
W84-00037

NATURE OF PHOSPHORUS FRACTIONS IN LAND RUNOFF AND THEIR AVAILABILITY TO ALGAE,
Cornell Univ., Ithaca, NY.
J. P. Barlow, D. R. Bouldin, R. T. Oglesby, W. R. Schaffner, and M. S. Glase.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111830, Price codes: A04 in paper copy, A01 in microfiche. Center for Environmental Research Completion Report, (1983). 63 p, 15 Fig, 11 Tab, 15 Ref. OWRT B-098-NY(1), 14-34-0001-1251.

Descriptors: *Phosphorus, *Biological availability, *Algal assay, Reactive phosphorus, Organic phosphorus, Sorption, Particulate phosphorus, Soil nutrient losses, *Agricultural runoff, New York.

Phosphorus in agricultural discharge and streams was examined for biological availability of soluble fractions and for the quantity of these in discharge. In streams, very little soluble P was detected, even during heavy flow. Although there was considerable variability in the concentration of P discharged from fields, the total amount lost was closely related to the amount of water discharged. Soluble P, both molybdate reactive and unreactive was largely biologically available as determined by algal bioassays and bioassays using natural pond microfloral assemblages. Soluble P which was less available after herbicide treatment or frosts may have resulted from breakdown of plant material. Sorption reactions during mixing of field discharge with stream water were estimated by adding increasing amounts of low P water to discharge water. Generally, soluble molybdate reactive P was absorbed and decreased in concentration while soluble unreactive P was desorbed and increased in concentration. Sorption was related to the quantity of suspended particulates.
W84-00043

TRACE METALS IN SEDIMENTS OF THE ST. JONES AND MURDERKILL RIVERS, DELAWARE,
Delaware Univ., Newark. Coll. of Marine Studies.
D. Hoffman, and R. Biggs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111897, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Completion Report, September 1983. 14 p, 2 Fig, 4 Tab, 2 Ref. OWRT A-055-DEL(1), 14-34-0001-2108.

Descriptors: *Trace metals, *Sediments, *Estuaries, *Delaware, Water chemistry, St. Jones River, Murderkill River, Copper, Cadmium, Zinc, Chromium, Iron, Lead, Manganese, Pollutant identification, Water pollution sources.

The metals Cu, Cd, Cr, Zn, Fe, Mn, Pb were analyzed from surface sediments from 47 locations in the Murderkill and St. Jones Rivers, Delaware. Prior to 1976, the St. Jones received domestic sewage from the City of Dover, Delaware. A regional sewage plant began operations in 1976 and discharged the combined wastes from Dover and surrounding areas into the Murderkill. Results of the 1982 metals survey were compared with data obtained by the same authors at the same locations in 1973. Cu, Cd, and Pb show higher concentrations in Murderkill bed sediments in 1982 than in 1973. These concentrations decrease in the mainstem river away from the STP discharge points. Cr, Fe, and Mg do not show such excursions and are indistinguishable from the 1973 concentrations. Metal concentrations in bed sediments of the St. Jones River show no change for 1973 to 1980, except that Pb, Cd and Zn sediment concentrations are generally lower in 1982. The analyses suggest that Cu, Cd, and Pb are increasing in the sediments from the Murderkill while Fe, Mn, and Cr are not. Pb, Cd, and Zn are decreasing in the St. Jones sediments, perhaps because they are being leached from the sediments or because they are being buried and diluted with clean materials.
W84-00049

METAL LOADING OF THE B. EVERETT JORDAN RESERVOIR,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. S. Shuman, K. G. Robinson, and C. E. Stokes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111913, Price codes: A04 in paper copy, A01 in microfiche. Report No 200, July 1983. 60 p, 7 Fig, 14 Tab, 30 Ref. OWRT A-112-NC(1), 14-34-0001-1135.

Descriptors: Metals, *Heavy metals, Zinc, Cadmium, Lead, Copper, Mercury, Streams, Rivers, *Reservoirs, Streamflow, Low flow, High flow, Suspended sediments, Particulate matter, Dissolved solids, Particle size, Municipal wastewater, Urban runoff, *North Carolina, B. Everett Jordan Reservoir.

Filterable and non-filterable Zn, Cd, Pb, Cu and Hg concentrations were examined in streams which form the B. Everett Jordan Reservoir, N.C. Stream samples were collected to coincide with low and high flow events. Zinc, Cu, Pb and Hg were transported principally in the non-filterable fraction and at high flow, whereas less than 20% of the Cd was transported in that fraction. Metal loadings were estimated from flow-weighted mean metal concentrations and mean stream flow data and indicated the importance of sampling during high flow events. Metal concentrations at high flow depended less on flow magnitude than the time relative to peak flow when the sample was collected. The order of metal loading was Zn>Cu>Pb>Hg with the industrialized Haw River sub-basin contributing more metals Zn (19.7 X 10 super 3 g/km super 2-yr), Cd (32.4 X 10 super 1 g/km super 2-yr), Pb (5.0 X 10 super 3 g/km super 2-yr), Cu (8.8 X 10 super 3 g/km super 2-yr), and Hg (4.2 X 10 super 1 g/km super 2-yr)), Pb (1.4 X 10 super 3 g/km super 2-yr) Cu (2.1 X 10 super 3 g/km super 2-yr) and Hg 2.5 g/km super 2-yr).
W84-00051

TRANSPORT OF POLLUTANTS IN NATURAL STREAMS,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
J. A. McCorquodale, E. H. Imam, J. K. Bewtra, Y. S. Hamdy, and J. K. Kinkead.
Canadian Journal of Civil Engineering, Vol 10, No 1, p 9-17, 1983. 4 Fig, 12 Ref.

Descriptors: *Organic compounds, *Industrial wastes, *Outfalls, Fate of pollutants, Model studies, Mathematical models, Mixing, St. Clair River, *Ontario, Rivers, Dispersion, *Path of pollutants.

Dispersion of soluble degradable and nondegradable pollutants discharged from multiple industrial sources into a large river was simulated by a two-dimensional mathematical model. The Akhtar (1978) model was modified to include the effect of depth and velocity variations in both longitudinal and lateral directions, the effect of rapid convergence or divergence of stream width, lateral convection of mass, the effect of flow diversion, the effect of jet mixing and dilution at shore-based and extended outfalls, and the removal rates of degradable trace organic pollutants. The model is divided into two parts: the river hydrodynamics model and the pollutant transport model. The model was validated by using phenol as a pollutant and comparing model results with observed data obtained from the St. Clair River, Ontario. A simulation using effluent discharges from 24 sources at 19 different locations produced results for phenol, benzene, toluene, methylene chloride, and carbon tetrachloride the agreed well with measured concentrations of the chemicals in river water. It was observed that pollutants disperse slowly when discharged in a shallow, slow-moving zone of the river and disperse rapidly once they reach the deeper water. The deeper the outfall, the faster the lateral dispersion of pollutants into the river. (Cassar-FRC).
W84-00072

DESIGN OF SEA OUTFALLS - THE LOWER LIMIT CONCEPT OF INITIAL DILUTION,
For primary bibliographic entry see Field 5E.
W84-00076

WASTE-RELATED CADMIUM CYCLE IN SWITZERLAND,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
L. Keller, and P. H. Brunner.
Ecotoxicology and Environmental Safety, Vol 7, No 1, p 141-150, 1983. 6 Fig, 6 Tab, 14 Ref.

Descriptors: *Cadmium, *Fate of pollutants, *Land disposal, *Spatial distribution, *Bioaccumulation, *Composting, *Sludge disposal, Heavy metals, Landfills, Soil amendments, Leaching, *Switzerland.

In Switzerland, an average of 120 tons of cadmium are used each year. Of this amount, an estimated 25 tons end up in municipal solid waste, 3 tons in wastewater, and 19 tons in precipitation and dry fallout. About 40 tons of cadmium annually are deposited directly to the soil via landfills, the atmosphere or the fertilization of agricultural land. Theoretically, the cadmium content of the soil may double in 150 years, thus increasing the cadmium content of plants grown on such soil. Model studies predict that soil cadmium levels should not exceed 3 ppm. At such levels, plants are likely to attain cadmium levels > 0.4 milligrams/kilogram, a concentration which can cause toxic effects in long term experiments. Since cadmium is not distributed evenly over Switzerland, the use of compost may render many soils unfit for the production of crops intended for human consumption in only 14 years. For sewage sludge application to cropland, this time span is 130 years. In a steady state, the cadmium input to soil should equal its output via plants, leachate, and erosion. The dissipative use of cadmium must be stopped if heavy metal limits in food are to be observed. (Geiger-FRC)
W84-00078

IMPACT OF DROUGHT ON QUALITY OF POTENTIAL WATER SUPPLY SOURCES IN THE SANGAMON RIVER BASIN,
Southern Illinois Univ. at Carbondale. Dept. of Thermal and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W84-00105

POLLUTANT-PARTICLE ASSOCIATIONS AND DYNAMICS IN COASTAL MARINE ENVIRONMENTS: A REVIEW,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. R. Olsen, N. H. Cutshall, and I. L. Larsen.
Marine Chemistry, Vol 11, No 6, p 501-533, 1982. 8 Fig, 182 Ref.

Descriptors: *Estuarine environment, *Water pollution sources, *Sedimentation, Dynamics, Coastal waters, *Reviews, Chemical reactions, Sediment transport, Fate of pollutants.

This review indicates that many pollutants rapidly become associated with particles in coastal marine environments and that these particles are then effectively trapped in the estuaries. This association may result from ionic sorption and flocculation, organic complexation and flocculation, hydrophobic interactions with particle surfaces, bio-aggregation, or sorption and co-precipitation with Mn-Fe hydroxides. The net transport of particles and associated pollutants is downstream in the lower salinity surface layer of an estuary, but as these particles settle to the more saline bottom they may be transported back upstream and trapped by estuarine circulation. The rate of particle-pollutant deposition is generally high and is governed to a great extent by estuarine sedimentary processes. Several processes such as sediment resuspension, diffusion from anoxic sediments, and dredging-dumping operations can reintroduce pollutants to marine waters which had already settled out. Dissolved nutrients that may escape an estuary stimulate productivity in near-shore coastal waters and are rapidly removed by biological processes, frequently forming plankton plumes at estuary mouths. Major removal mechanisms for pollutants in shelf waters include sorption onto resuspended sediments, incorporation into living organisms and sinking of

organic debris or boundary-layer scavenging in association with the redox cycling of Mn-Fe hydroxides. Of prime importance in any predictive model is a quantitative understanding of the rates associated with the biogeochemical processes that affect pollutant-particle dynamics. These process-oriented transfer rates include: input rates into the marine environment, exchange rates across the air-sea interface, transport rates in the water column, and transfer into and out of the sediments. Quantitative values for the above transfer rates are needed to determine particle-pollutant fluxes and define how long a pollutant will persist. (Baker-FRC)
W84-00141

A METHOD FOR CALCULATING THE RATE OF BIOSEDIMENTATION THROUGH THE LOWER BOUNDARY OF THE PHOTOSYNTHETIC ZONE IN SEA WATER,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 1B.
W84-00143

MICROBIOLOGICAL CONDITIONS AND WATER QUALITY IN THE LOWER DNIEPR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
E. Ya. Rossova, T. G. Moroz, R. A. Kokoreva, G. N. Shakhman, and T. L. Aleksenko.
Hydrobiological Journal, Vol 18, No 2, p 52-57, 1982. 5 Fig, 1 Tab, 12 Ref.

Descriptors: Water quality, *Bioindicators, Lakes, Dniepr River, Rivers, *Water quality control, Indicators, Microbiological studies, Bacteria, Seasonal variation, Bacterioplankton, *USSR.

The microbiology of the lower Dniepr was investigated and its water quality evaluated based on microbiological, hydrobiological and hydrochemical properties. The decomposition of organic matter and the self-purification of water occurred at the highest rates in the branches of the Dniepr within the city of Kherson in spring and summer. The degree of pollution and water quality of various sections of the lower Dniepr varied by seasons. Above and below Kherson, the Dniepr in all seasons except summer is pure or only slightly polluted (oligo-saprobic water). In summer the water is of lower quality (oligo-beta-mesoprobic). In general, the lower Dniepr is pure or only moderately polluted, but its branches within the city are moderately or strongly polluted (beta-alpha-mesosaprobic). (Baker-FRC)
W84-00148

PETROLEUM HYDROCARBONS IN SEDIMENTS OF SOUTHAMPTON WATER ESTUARY,
Bermuda Biological Station for Research, St. George's West.
A. H. Knap, P. J. Leb, P. J. L. Williams, and E. Lysiak.
Marine Environmental Research, Vol 7, No 4, p 235-249, 1982. 4 Fig, 6 Tab, 29 Ref.

Descriptors: *Industrial wastes, *Sedimentation, *Estuaries, Southampton, Refineries, Petroleum industry, Petroleum hydrocarbons, Water pollution sources, Fate of pollutants, *England.

Components of the total carbon cycle in Southampton Water have been investigated. Southampton Water estuary is a typical coastal plain estuary formed from the drowned lower portions of the Test and Itchen Rivers. About 75% of the total industrial discharge to the estuary is from a refinery. The non-volatile input ranges from 1 to 2 tons per day. Data indicate that the industrial outfalls on the southwestern bank of the estuary may be regarded as a substantial point source. Surface sediment hydrocarbon concentrations in the vicinity of the refinery were in the region of 1-3 mg C/g dry weight, falling to 0.5 mg C/g or less at a distance from the refinery. In the vicinity of the refinery Pb-210 dating of a core suggested a very high sedimentation rate, with a petroleum hydrocarbon horizon deeper than 3.5 m in at least one case. In another core, elevated hydrocarbon concentrations at 50-70 cm depth coincided well with elevated copper concentrations at those depths. The hydrocarbon concentrations in surface sediments distant from the refinery were not considered high in relation to other industrialized estuaries, thus demonstrating the importance of sediment adsorption as a mechanism of deposition of petroleum hydrocarbons close to the source. (Baker-FRC)
W84-00150

THE KINETICS OF THE OXIDATION OF FERROUS IRON IN SYNTHETIC AND NATURAL WATERS,
Freshwater Biological Association, Windermere (England).
W. Davison, and G. Seed.
Geochimica et Cosmochimica Acta, Vol 47, No 1, p 67-79, 1983. 5 Fig, 4 Tab, 50 Ref.

Descriptors: *Kinetics, *Iron, *Oxidation, Surface waters, Seasonal variations, Acidity, Particulates, Chemical reactions, Lakes, *Fate of pollutants, Laboratory studies, Anoxic conditions, *England, Esthwaite Lake.

The rate of oxidation of ferrous iron in natural waters was measured in the laboratory under conditions which were as close as possible to natural. Verification of the rate law by investigating the effect of pH, partial pressure of oxygen, and the influence of natural solid phases and changing microbial populations was attempted while maintaining natural conditions. Anoxic water samples were collected from the hypolimnion of a seasonally anoxic lake, Esthwaite Water in the English Lake District, on different days during the summer period of anoxia. The data were consistent with the simple rate law for homogeneous chemical kinetics previously established for synthetic solutions. The rate constant for the oxidation reaction in lake water was indistinguishable from that measured in synthetic samples. It did not appear to be influenced by changes in the microbial populations or by changes in any particulate or soluble components in the water, including iron and manganese. Analysis of the errors inherent in kinetic measurements showed that the estimation of pH was the major error source and that values of the rate constant determined by different workers could easily differ by a factor of six. A universal rate constant is suggested for natural freshwaters in the pH range 6.5 to 7.4. Discrepancies in the effects of ionic strength and interfering substances reported in the literature are highlighted. Generally substances have only been found to interfere at concentrations which far exceed those in most natural waters. (Baker-FRC)
W84-00154

SOURCES, SINKS, AND DISTRIBUTION OF ORGANIC CARBON IN THE ST. LAWRENCE ESTUARY, CANADA,
Bedford Inst. of Oceanography, Dartmouth (Nov Scotia). Atlantic Oceanographic Lab.
F. C. Tan, and P. M. Strain.
Geochimica et Cosmochimica Acta, Vol 47, No 1, p 125-132, 1983. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Sinks, *Estuaries, *Organic compounds, Carbon, Water pollution sources, Plankton, Sedimentation, Rivers, Gulf of St. Lawrence, Canada, St. Lawrence Estuary, Path of pollutants.

The sources and sinks of the organic carbon in the St. Lawrence Estuary and Gulf of St. Lawrence in Canada were investigated by carbon isotope ratio analysis of particulate, planktonic, and sedimentary organic carbon and dissolved inorganic carbon. In the upper St. Lawrence Estuary particulate organic carbon (POC) isotope ratios are uniform and indistinguishable from those of POC in the St. Lawrence River and of planktonic organic carbon in both areas. The abundance of freshwater diatoms in the upper Estuary suggests that upper Estuary POC is mainly fresh organic matter of riverborne origin. Upper estuary POC is isotopically different from POC in the lower St. Lawrence estuary and Gaspe regions, but is not different from POC from the surface waters of the open Gulf of St. Lawrence. The isotopic composition of planktonic organic carbon mirrors that of the POC, indicating that the POC in the lower estuary is also fresh organic matter. Since the lower estuary POC forms an isotopic barrier between the upper estuary POC and the Gulf of St. Lawrence POC, there appears to be little mixing of POC between these three reservoirs. Therefore POC in the lower estuary and gulf is most likely both produced and deposited in situ. The isotope ratio differences between the planktonic and dissolved inorganic carbon reservoirs shows that the difference varies significantly and somewhat unpredictably between sectors of the area studied. Thus one must use caution in assuming a constant fractionation factor and in applying such a factor to the interpretation of carbon isotope data. (Baker-FRC)
W84-00155

LEVELS OF HEAVY METAL POLLUTANTS IN TWO SPECIES OF MARINE NEMATODES,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
R. Howell.
Marine Pollution Bulletin, Vol 13, No 11, p 396-398, 1982. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Nematodes, *Metals, Fate of pollutants, Invertebrates, Heavy metals, Copper, Zinc, Lead, Cadmium, Mercury, Budle Bay, Blythe Estuary, Tees Estuary, *United Kingdom, Enoplus, Benthic fauna, Estuaries.

Heavy metals were determined in two nematode species collected from three sites on Britain's northeast coast: Budle Bay (nonpolluted), Blythe Estuary (significantly polluted), and Tees Estuary (extensively polluted). Mean metal concentrations (ppm) in Enoplus brevis at the 3 sites were: Cu, 61-245; Zn, 147-649; Pb, 20-42; Cd, 8-11; and Hg, 0.15-0.96. Mean metal concentrations (ppm) in Enoplus communis were: Cu, 33-60; Zn, 105-1865; Pb, 14-37; Cd, 5-51; and Hg, 0.11-1.22. Metals levels were lowest in Budle Bay and highest in Tees Estuary, except for Pb and Hg in E. brevis and Zn and Cd in E. communis. (Cassar-FRC)
W84-00158

AN ASSESSMENT OF MARINE POLLUTION IN PUGET SOUND,
National Oceanic and Atmospheric Administration, Seattle, WA. Office of Marine Pollution Assessment.
E. R. Long.
Marine Pollution Bulletin, Vol 13, No 11, p 380-383, 1982. 1 Fig.

Descriptors: *Organic compounds, *Metals, *Marine animals, Fate of pollutants, Puget Sound, Washington, Aromatic hydrocarbons, Water pollution effects, Fish, Pesticides, Chlorinated hydrocarbons, Marine Ecosystems Analysis Report, *Washington.

Selected results of the Marine Ecosystems Analysis Puget Sound project, initiated in 1978, are reported. Routinely analyzed were 27 aromatic hydrocarbons, 13 chlorinated pesticides, 37 metals, polychlorinated biphenyls (PCB), and chlorobutadienes in sediments and organisms. The highest mean contaminant levels in sediments and sole livers, respectively, were: PCB, 380 ppb and 35,000 ppb; total chlorobutadienes, 1600 ppb and 9100 ppb; hexachlorobenzene, 74 ppb and 3700 ppb. Total aromatic hydrocarbons levels reached a high of 13,000 ppb (mean value). Highest trace metals concentrations were: Hg, 1900 ppb; Pb, 630,000 ppb; As, 470,000 ppb; and Cd, 18,000 ppb. A large variety of histopathological conditions were observed among fish, shrimp, and crabs collected in the most heavily polluted sites, Elliott and Commencement Bays, near the urban centers of Tacoma and Seattle. Species compositions of marine fauna also reflected the pollution levels. Findings of this study show that the marine resources of Puget Sound, perceived as clean by consumers, are highly contaminated by toxic chemicals in some areas. (Cassar-FRC)
W84-00159

THE USE OF STRONTIUM-87/STRONTIUM-86 RATIOS TO MEASURE ATMOSPHERIC TRANSPORT INTO FORESTED WATERSHEDS,
Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.
W. C. Graustein, and R. L. Armstrong.
Science, Vol 219, No 4582, p 289-292, January 21, 1983. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Strontium, *Nutrients, *Aerosols, Tracers, Fate of pollutants, *Forest watersheds, *Air pollution, Trees, Spruce trees, Aspen trees, Bedrock, Weathering, Deposition, Leaves, *New Mexico, Sangre de Cristo Mountains.

The Sr87/Sr86 ratio was used as a tracer to determine the sources of Sr in natural waters, vegetation, and soils in two small forested watersheds, one covered with aspen and the other with Engelmann spruce and subalpine fir, in the Sangre de Cristo Mountains, New Mexico. This mountain range, 1.6 billion years old, has a higher Sr87/Sr86 ratio than the surrounding, lower terrain, 0.6 billion years old, from which atmospheric Sr aerosols and dust are deposited on vegetation. Dust input from remote areas provided 75% of the Sr in the aspen vegetation; 80% in the spruce vegetation. The remainder of the Sr is derived from weathering of bedrock. The conifers intercepted most of the Sr-bearing aerosol in the watershed; very little was trapped by the deciduous foliage. Sr and nutrients are cycled continuously through a system consisting of upper soil horizons, forest litter, and vegetation. (Cassar-FRC)
W84-00176

SOIL SOLUTE CONCENTRATION DISTRIBUTIONS FOR SPATIALLY VARYING PORE WATER VELOCITIES AND APPARENT DIFFUSION COEFFICIENTS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 2G.
W84-00188

AN EVALUATION OF SELECTED HALOCARBONS AND TRACE GASES FOR POTENTIAL USE AS INDICATORS OF GROUNDWATER MOVEMENT AND SOURCE (AND CONTAMINANT MOVEMENT IN THE VADOSE ZONE),
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
D. K. Kreamer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-117266, Price codes: A03 in paper copy, A01 in microfiche. Arizona Water Resources Research Center Completion Report, March 1983. 26 p, 7 Fig, 2 Tab, 4 Ref. OWRT A-111-ARIZ(1), 14-34-0001-1103.

Descriptors: *Tracers, Tracking techniques, *Indicators, Path of pollutants, Pollutants, Water pollution, *Groundwater movement, *Groundwater pollution, Vadose zone, Halocarbons.

Selected trace gases were evaluated as indicators of groundwater movement and source. Measurable quantities of trichloroethylene (TCE), perchloroethylene (PCE), 1,1,1-trichloroethane (TCA), chloroform (CCl sub 3 H), trichlorofluoromethane (F-11), methylene chloride (CH sub 2 Cl sub 2), carbon tetrachloride (CCl sub 4), and other trace gases were found in the gaseous component of the vadose zone. A technique was developed to use these compounds in the gas phase as indicators of groundwater pollution and contaminant migration. TCE was found in concentrations of 0.7 and 8.5 mu g/l respectively for the Phoenix well 35 and Salt River Project well 23.6E-6N, at respective depths of 9.3 and 17.8 feet below ground surface, (approximately 200 and 70 feet above the saturated zone). Halocarbons were measured in the atmosphere above ground, in the gaseous phase at depths of 10, 20, 50, and 90 feet below land surface, and in the groundwater at the Carranza well, Tucson, Arizona. TCE, CCl sub 4, PCE, and CCl sub 3 H showed gradients that increased in concentration toward the water table, indicating a local subsurface of water table source. F-11, TCA, and CH sub 2 Cl sub 2 showed decreasing concentration with depth indicating a possible atmospheric origin. Distribution coefficients between water and gaseous phases were found to be higher in field conditions as compared to laboratory conditions for F-11, CHCl sub 3, CCl sub 4, and PCE, and lower for TCE and CH sub 2 Cl sub 2.
W84-00201

TRACE METAL CONTAMINATION OF SHALLOW MARINE SEDIMENTS NEAR A LEAD SMELTER, SPENCER GULF, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Fisheries and Oceanography.
T. J. Ward, and P. C. Young.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 45-46, 1981. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Heavy metals, *Marine sediments, *Bays, Industrial wastes, Organic carbon, Cadmium, Calcium, Copper, Minerals, Magnesium, Manganese, Nickel, Lead, Zinc, Silt.

The surface (< 10 cm) marine sediments of Spencer Gulf, a hypersaline seagrassed embayment, near Port Pirie, South Australia, were examined for concentrations of calcium, cadmium, copper, magnesium, manganese, nickel, lead, zinc, total organic carbon, clay, silt, sand, shell, and 'undissolved fraction' (resistant plant debris). Elevated concentrations of lead, copper, zinc, manganese and cadmium were found in sediments adjacent to the liquid effluent discharge from a lead smelter. Outside the immediate discharge area the concentrations of copper and manganese rapidly approached background levels where their concentrations were correlated to those of noncontaminant sediment parameters. The highest concentrations of cadmium were found further from the source of effluent than those of the other four contaminant metals (copper, manganese, lead, zinc), and decreased to undetectable levels at the furthest site. Lead and zinc also occurred at background concentrations at sites away from the effluent discharge, but no correlations were found between these two metals and other sediment parameters. At sites away from the immediate discharge area no interaction was detected between contaminant metals, sediment parameters, and presence or type of seagrass meadow. (Author's abstract)
W84-00312

MUTAGENICITY OF POTENTIAL EFFLUENTS FROM AN EXPERIMENTAL LOW BTU COAL GASIFIER,
Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM. Inhalation Toxicology Research Inst.
J. M. Benson, C. E. Mitchell, R. E. Royer, C. R. Clark, and R. L. Carpenter.
Archives of Environmental Contamination and Toxicology, Vol 11, No 5, p 547-551, 1982. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Coal gasification, *Mutagenicity, *Industrial wastes, Public health, Design criteria, Organic compounds, Salmonella strain TA98, Salmonella.

Mutagenicity of potential waste effluents produced by an experimental low Btu coal gasifier was studied in Salmonella strain TA98. Samples studied included producer bottom ash and cyclone dust with little associated organic matter, tars, and water containing organic compounds condensed from the process stream. The organic compounds present in potential waste effluents, except for bottom ash, were mutagenic in Salmonella strain TA98. Except in the case of LH-20 fractions from tar-trap tar, metabolic activation was required for a mutagenic effect. These results indicate that potential gasifier effluents contain compounds which, following metabolism, become frameshift mutagens; others may also be formed. Results of chemical fractionation studies indicate that neutral and polar polycyclic aromatics contributed to the mutagenicity, although in the case of tar-trap tar, other classes of compounds also contributed to the biological activity. Potential health hazards associated with these findings should be considered in the design of future coal gasification facilities. (Baker-FRC)
W84-00317

HEAVY METAL ABSORPTION BY WINTER WHEAT FOLLOWING TERMINATION OF CROPLAND SLUDGE APPLICATIONS,
California Univ., Riverside. Dept. of Agriculture.
A. C. Chang, A. L. Page, and F. T. Bingham.
Journal of Environmental Quality, Vol 11, No 4, p 705-708, October-December, 1982. 7 Tab, 17 Ref.

Descriptors: *Metals, *Sludge disposal, *Sand application, Wheat, Cadmium, Zinc, Heavy metals, Land disposal, Fate of pollutants.

Municipal sludge was applied to a test plot near Rio Vista, California, from 1973 through 1976, at the rate of 33, 66, 107, and 147 tons per ha. Total inputs of heavy metals at the highest application rate (kg per ha) were: Cd, 6.24; Cu, 86.2; Ni, 20.6; Pb, 148.2; and Zn, 567.0. Soils and winter wheat crops were sampled in 1979 and 1980. Grain yields from the land treated with 147 tons per ha of sludge were significantly higher than from control plots. Metals contents (micrograms per g) were: wheat straw--Cd, 0.07-0.16; Zn, 19-26; wheat grain--Cd, 0.04-0.09; Zn, 22-45. These values were slightly higher than in controls but were well within the range typical for wheat grown on uncontaminated soils. Levels of Cu, Ni, and Pb were not elevated in the plant tissue. Added metals were confined almost entirely to the 0 to 15 cm soil layer, in which they were incorporated by plowing. Cd appeared to have a greater tendency to migrate than the other metals. Acidity, electrical conductivity, and water-extractable Cd and Zn levels of the soil were not changed by the sludge treatments. (Cassar-FRC)
W84-00328

OPTIONS FOR HANDLING STILLAGE WASTE FROM SUGAR-BASED FUELS ETHANOL PRODUCTION,
East-West Environment and Policy Inst., Honolulu, HI.
I. P. Willington, and G. G. Marten.
Resources and Conservation, Vol 8, No 2, p 111-129, 1982. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Industrial waste, *Waste disposal, *Fuel, Stillage processing wastes, Ethanol production, Water pollution sources, Sugars, Hawaii.

Stillage waste from ethanol fuel production can be a serious source of water pollution but it can also be a valuable resource from which to recover useful products such as fertilizer, animal feed, or methane gas. Various possibilities for stillage handling include discharge to adjacent waterway or land area, marine outfall, return to agricultural fields, conventional sewage treatment, lagoon treatment, anaerobic digestion with methane production, incineration to ash for subsequent use as fertilizer, and evaporation to an animal feed. These options vary enormously in their environmental characteristics and the degree to which they are commercially proven, consume or produce energy, lead to useful by-products and cost or generate money. The cost depends on the wastewater characteristics, applicable ambient and emission standards, energy requirements of the distillery, economics, availability and cost of land, and the location of the distillery relative to receiving waters and byproduct markets. The environmental impacts of alcohol stillage upon water quality and the aquatic ecosystem include depletion of dissolved oxygen, discoloration, odors, eutrophication, salinization, acidification, increases in water temperature, changes in species composition of aquatic flora and fauna, and fish kills in extreme cases. The formation of a clearing-house for stillage processing information is proposed to offer assistance to those in need of making the many decisions regarding proper disposal of stillage waste products. (Baker-FRC)
W84-00330

ACCUMULATION OF HEAVY METALS IN UNICELLULAR ALGAE,
Monash Univ., Clayton (Australia). Dept. of Chemical Engineering.
D. Khummongkol, G. S. Canterford, and C. Fryer.
Biotechnology and Bioengineering, Vol 24, No 12, p 2643-2660, December, 1982. 9 Fig, 2 Tab, 33 Ref.

Descriptors: *Accumulation, *Heavy metals, *Model studies, *Fate of pollutants, Algae, Microorganisms, Bioaccumulation, Adsorption, Metals, Phosphates, Cadmium.

A model for metal uptake by microorganisms based on surface adsorption was formulated and applied to cadmium (Cd) uptake by Chlorella vulgaris. When cell growth is modeled, an initial rapid uptake and a subsequent slow uptake is predicted due to the simultaneous effects of growth and surface adsorption. Experimental results in a batch system confirm the rapid initial uptake of metals within a few seconds. This equilibrium is affected by phosphate concentration; the amount of CD adsorbed on the cell decreases as the phosphate level increases. Long-term uptake experiments in growing cultures show a greater metal accumulation than predicted by the adsorption model suggesting the involvement in the slow long-term uptake of some mechanism other than adsorption. A model which incorporates a description of adsorption and of intracellular accumulation is needed to provide a more complete description of metal uptake by microorganisms. (Geiger-FRC)
W84-00331

BIOAVAILABILITY OF PHOSPHORUS INPUTS TO LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. C. Sonzogni, S. C. Chapra, D. E. Armstrong, and T. J. Logan.
Journal of Environmental Quality, Vol 11, No 4, p 555-563, October-December, 1982. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Phosphorus, *Eutrophication, *Lakes, Phosphates, Water pollution sources, Fate of pollutants, Reviews, Algae, Sediment, Adsorption, Desorption, Water quality management, Agricultural runoff, Suspended sediments, Pollutant identification.

Current information on the bioavailability of forms of phosphorus delivered to lakes from different sources is reviewed with attention to management implications. Dissolved P is readily available for use by algae and higher plants, either directly (inorganic P) or readily convertile (condensed P and organic P). Particulate P is partially available for biological use in the inorganic form (nonapatite inorganic P) and convertile to dissolved reactive P in the organic and condensed forms. Inorganic P in the apatite inorganic form is essentially unavailable. Methods of analyzing for bioavailable inorganic P are described. Potentially available P corresponds with the dissolved reactive P (DRP) plus the fraction of particulate inorganic P obtained by extraction with 0.1 N NaOH. Natural factors influencing bioavailability include the rate of P release from suspended particles, the rate of settling of suspended particles, the equilibrium concentration of DRP, algal uptake, and phosphate desorption rates. Potential bioavailability has been estimated at 20-80% of total P input, usually in the lower part of the range. P sources include agricultural and urban runoff, water and wind erosion, fertilizers, atmospheric deposition, and wastewater effluents. Management programs for lakes should consider bioavailability of P to avoid costly overcontrol of P inputs. Most efficient P management should attack the sources highest in DRP: municipal point discharges and excessive fertilizer application. (Cassar-FRC)
W84-00336

EVALUATION OF NITROGEN AND IRRIGATION MANAGEMENT FOR CORN PRODUCTION USING WATER HIGH IN NITRATE,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
D. L. Martin, D. G. Watts, L. N. Mielke, K. D. Frank, and D. E. Eisenhauer.
Soil Science Society of America Journal, Vol 46, No 5, p 1056-1062, September/October, 1982. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Nitrogen, *Crop yield, *Groundwater pollution, *Irrigation, Nitrates, Fertilizers, Corn, Groundwater management, Nitrogen uptake.

The interaction of N and water management for corn production was studied using a field-calibrated computer model. The study was conducted on sandy soils in the central Platte Valley of Nebraska. Nitrogen uptake was strongly influenced by the amount of fertilizer N and irrigation water applied and to a lesser extent by the nitrate-nitrogen concentration of the irrigation water. There was also a strong interaction of these parameters in determining N uptake. The uptake efficiency of fertilizer N was very sensitive to excess irrigation and only slightly affected by the amount of fertilizer applied or the nitrate-nitrogen concentration of the irrigation water. The uptake efficiency of groundwater N was strongly affected by the amount of irrigation water applied and the nitrate-nitrogen concentration of the water, while the amount of fertilizer applied had a lesser effect. Groundwater uptake efficiencies in general were higher and more stable than fertilizer uptake efficiencies. Excess irrigation increased N uptake from groundwater sources under certain conditions. The groundwater N contribution to uptake was large for irrigation water containing more than 10 ppm nitrate-nitrogen and was primarily determined by the amount of irrigation and the nitrate-nitrogen concentration. For 25 ppm nitrate-nitrogen irrigation water and small fertilizer applications more N was extracted from the groundwater through irrigation than was lost due to leaching. (Baker-FRC)
W84-00344

5C. Effects Of Pollution

FEASIBILITY AND EFFECTS OF WATER QUALITY ON BAIT-FISH CULTURE IN AERATED SEWAGE TREATMENT LAGOONS IN VERMONT,
Vermont Univ., Burlington.
G. W. LaBar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110790, Price codes: A02 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, September 1983. 11 p, 1 Tab, 14 Ref. OWRT A-044-VT(1).

Descriptors: Wastewater, *Aquaculture, Water quality, *Lagoons, *Vermont, Sewage treatment, *Shiners.

Golden shiners (Notemegonus chrysoleucas) were successfully cultured in 1 m super 3 floating cages in the final lagoon of an aerated lagoon-type sewage treatment facility in Milton, Vermont. The mortality rate at densities of 50 and 100/m super 3 was 6% and 8% respectively, and at 200/m super 3 was 34% over a two-month period. Zinc concentration increased from 2.0 to 6.6 ppm during the same period, while cadmium, lead, and chromium concentrations did not change significantly.
W84-00006

CELLULAR BIOASSAY OF FISH AS A SENSITIVE INDEX OF WATER QUALITY RELATED TO ASH FROM COAL COMBUSTION,
West Virginia Univ., Morgantown. Water Research Inst.
D. E. Hinton, E. R. Walker, and D. M. Kontir.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110824, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, 1983. 78 p, 12 Fig, 9 Tab, 53 Ref. OWRT A-045-WV(1), 14-34-0001-2152.

Descriptors: *Acid mine water, Analysis, *Analytical techniques, *Bituminous coal, *Cytological studies, Fish, *Fly ash, Methodology, Trace elements, Water Quality, Burning, Chemical Analysis, Electric powerplants, Energy, Evaluation, Metals, Water pollution, *Bioassay, *Trout.

Static exposure of aqueous suspensions of ash from coal combustion to Oryzias latipes (embryo), Pimephales promelas, and Salmo gairdoeri (adults) was done to determine whether cells of gill, gut, and/or lateral-line system could phagocytose particulates. Energy dispersive X-ray microanalysis of specific cells in gill did not reveal presence of particulates after exposure. Studies on intestine and lateral line are continuing. Effects of uptake of one coal associated polynuclear aromatic, 3-methylcholanthrene (3-MC), were studied in trout liver by a coupled structure/function approach. 3-MC caused induction of liver microsomal benzo(a)pyrene (BP) hydroxylasse activity but did not affect epoxide hydrase activity. In-vitro microsomal metabolism of BP was qualitatively and quantitatively altered by prior 3-MC exposure. No morphologic alternations accompanied biochemical changes. Field studies to assess effects of coal combustion byproducts on feral fish tissues and enzymes are continuing.
W84-00009

PLANKTON AND BENTHIC INSTREAMFLOW CRITERIA, STRATEGY, AND HABITAT DELINEATION IN ACID-CONTAINING WATERS,
West Virginia Univ., Morgantown. Water Research Inst.
E. C. Keller, Jr., D. K. Werner, R. B. Gerber, and A. J. Becker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110840, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, 1983. 87 p, 38 Fig, 25 Tab, 46 Ref, 1 Append. OWRT A-048-WVA(1), 14-34-0001-2152.

Descriptors: *Acid mine drainage, *Aquatic habitats, *Benthos, *Chemical properties, *Data interpretation, *Instream flow, *Plankton, Streamflow, Water quality, *Water quality standards, Acid streams, Acidic water, Aquatic life, Assessments, Benthic fauna, Benthic flora, Ecology, Ecosystems, Mine drainage, *West Virginia, Pennsylvania.

Eight homogenous river segments were identified, through cluster analysis, in the upper Monogahela River Basin viz, Cheat Lake, Tygart Lake, an acid drainage segment of the middle Cheat, the lower Monongahela (to Pt. Marion, PA), the upper Monongahela, the upper Cheat, the lower Blackwater River, and the Westfork River (south to Clarksburg, WV). Regression analyses of data from within these segments indicated that instream flow was highly associated with Total Algal Biomass in several of the segments. Regression analyses also showed that instream flow had very little association with the Algal Genera Distribution. The segmental approach to determine these algal associations with instream flow was an extremely effective approach, since considerably more variation in Total Algal Biomass could be explained using the segmental approach as compared with the use of all of the variable data. Five variables showed a general positive association with general instream flow in the basin viz, calcium, conductivity, hardness, magnesium, and dissolved oxygen. Consistent temporal changes in water quality occurred throughout the upper Monongahela River basin within the three sub-basins viz, the Monongahela, the Tygart Valley, and the Cheat Rivers, some fourteen variables showed consistently increasing trends and 14 showed consistently decreasing trends.
W84-00011

FOOD CHAIN ENRICHMENT OF ORGANOCHLORINE COMPOUNDS AND MERCURY IN CLEAN AND POLLUTED LAKES OF FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W84-00023

EFFECTS OF CADMIUM ON STREAMS AND IRRIGATED AGRICULTURE IN THE PRESENCE AND ABSENCE OF OIL SHALE LEACHATE,
Utah Water Research Lab., Logan.
D. A. Selby, J. M. Ihnat, F. J. Post, and J. J. Messer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111707, Price codes: A08 in paper copy, A01 in microfiche. Water Quality Series UWRL/Q-83/08, August 1983. 148 p, 28 Fig, 26 Tab, 216 Ref, 2 Append. OWRT B-214-UTAH(1), 14-34-0001-1280.

Descriptors: *Oil shale, *Leachate, *Cadmium, *Alfalfa, *Chelation, Environmental effects, Crop production, Stream microcosms, Aufwuchs, Invertebrates, Substrates, Benthic environment, Benthic fauna, Nitrification, Utah, Colorado, Water pollution effects.

The goal of this study was to identify potential effects should oil shale leachates in Utah and Colorado reach hardwater stream ecosystems or irrigate agricultural lands. The experimental work focused on interactions between raw oil shale leachate and heavy metals in concentrations naturally occurring in these streams and how these interactions affect the toxicity and bioaccumulation of metals. For the studies on hardwater streams, eight identical stream microcosms were constructed and allowed to establish self-sustaining communities of aufwuchs and invertebrates on natural river substrates. Pairs of streams were exposed to treatments of 20 ug Cd/1 representing the most severe likely concentration in the natural streams), 20 ug Cd/1 plus leachate from crushed raw oil shale, and crushed raw oil shale leachate alone. The other two streams were controls. After three weeks, sampling was conducted to determine changes in community structure and observe biological cadmium accumulation. Clorophyll ratios, aufwuchs biomass, invertebrate density, and invertebrate drift showed no measureable effects. However, cadmium accumulations were recorded in aufwuchs, macro-phytes, invertebrates grazers, particulate feeders, predators, and stream sediments but not affected by the oil shale leachate. Cadmium accumulations by aufwuchs are largely associated with cellular surfaces. Effects of oil shale leachate on cadmium toxicity and accumulation in crops were studied using alfalfa and radish plants with the same four treatments. The plants accumulated up to 4.0 ug/g dry weight cadmium, and slightly higher cadmium accumulations occurred with oil shale leachate. None of the treatments affected crop productivity.
W84-00030

THE INDUCTION OF TOLERANCE TO HEAVY METALS IN NATURAL AND LABORATORY POPULATIONS OF FISH,
Kentucky Water Resources Research Inst., Lexington.
W. J. Birge, W. H. Benson, and J. A. Black.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111756, Price codes: A03 in paper copy, A01 in microfiche. Research Report No 141, June, 1983. 31 p, 1 Fig, 8 Tab, 29 Ref. OWRT A-087-KY(1), 14-34-0001-2119(FY82).

Descriptors: *Cadmium, *Copper, Embryos, Larvae, Water quality, Zinc, *Heavy metals, Water pollution effects, Acclimation, *Toxicity tests, *Bioaccumulation, Fathead minnow, Tolerance.

Aquatic toxicity studies were performed on two natural populations of fathead minnows. One group of organisms was taken from a metal-contaminated flyash pond associated with a coal-fired power plant and the other group was collected from relatively uncontaminated hatchery ponds. Acute tests indicated that flyash pond fish were significantly more tolerant to cadmium and copper than were hatchery fish. As an exposed concentration of 6.0 mg Cd/L in moderately hard water, the median period of survival for flyash pond fish was 50.0 hr compared to 6.8 hr for hatchery fish. Both groups of organisms were about equally sensitive to zinc. The metal-induced tolerance observed with animals from the flyash pond was not a sustained response. Additional studies were undertaken to observe the response of laboratory populations of fathead minnows to acutely toxic cadmium concentrations following acclimation to sublethal exposures of this metal. Based on 96-hr LC sub 50 values, those animals which had recieved 35-days prior exposure to 10 and 50 ug CD/L were 63 to 68% more tolerant to cadmium than were previously unexposed organisms. As with the natural population, tolerance to cadmium in the laboratory fish was not retained. After organisms which had been acclimated to 1o ug Cd/L were transfered to clean water, tolerance to cadmium decreased by three and one-half fold after only 7 days. Developing embryos of the fathead minnow and rainbow trout also acquired tolerance to cadmium. After eggs of the trout had been exposed to 0, 5, and 50 ug Cd/L for 24 days, subsequent acute toxicity tests gave 7-day LC sub 50 values of .7, 1, 59, and 2.02 ug Cd/L, respectively.
W84-00035

RECOVERY PATTERNS IN STREAM COMMUNITIES IMPACTED BY THE MT. ST. HELENS ERUPTION,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
P. Wilzbach, T. L. Dudley, and J. D. Hall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111798, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-83, Oregon State Univ., Corvallis, August 1983. 33 p, 6 Fig, 6 Tab, 11 Ref, 2 Append. OWRT A-059-ORE(1), 14-34-0001-2139.

Descriptors: *Stream recovery, *Stream habitats, *Habitat recovery, *Stream biological communities, Stream biota, Stream fisheries, Aquatic habitats, *Aquatic habitat recovery, Benthic communities, Sedimentation, Channel erosion, Channel scour, Channel morphology, *Mt. St. Helens, *Washington.

Recovery patterns of benthic communities in seven small streams impacted to varying degrees by the eruption of Mt. St. Helens were examined in winter 1981-82, particularly in relation to habitat constraints. Overall abundance and diversity of the communities were low, and instability of channel banks appears to severely limit re-establishment of biota. Communities appear to be undergoing cycles of establishment and denudation in concert with changes in landscape geomorphology. Disturbance events of varying frequencies were also simulated in experimental stream channels to more closely evaluate the response of benthic communities to periodic, non-catastrophic disturbances and to compare this with the response observed to catastrophic perturbation associated with volcanic eruption. Results of simulations suggest that non-catastrophic disturbances may not play a major role in determining stream community over ecological time because the predictability of these events may have enabled evolution in species of adaptive responses to cope with disturbance. Catastrophes appear to have different consequences on stream communities from other disturbances and should be distinguished from them.
W84-00039

THE EFFECTS OF AGRICULTURAL RUNOFF UPON NATURAL WETLAND ECOSYSTEMS,
Concordia Coll., Moorhead, MN. Dept. of Biology.
G. L. Vanamburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111905, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, September 1983. 40 p, 15 Fig, 8 Tab, 22 Ref. OWRT A-044-MINN(1), 14-34-0001-2125.

Descriptors: *Wetlands, *Agricultural Runoff, *Fertilizers, Nutrients, Productivity, *Minnesota, *Marshes, Ammonia, Nitrogen, Ecosystems.

The purpose of the study was to examine the functioning of the major wetland ecosystem compartments. Two prairie glacial marshes in western Minnesota were studied. The major compartments studied were: (1) watershed soils, (2) watershed runoff, (3) emergent macrophytes, (4) submergent plants, (5) wetland sediment, and (6) wetland waters. Ammonia and nitrate forms of nitrogen contributed significantly to nitrogen entering the wetlands via runoff. Above ground biomass of Typha peaked in mid July ranging from 650 to 988 g/m super 2. Below ground biomass reached a maximum in June, declined until late summer, then recovered to values recorded in early spring. Nitrogen concentrations in Typha shoots increased in early spring then declined throughout the season. Nitrogen concentration of the rhizomes and roots was less than in the shoots, except late in the season. Nitrogen content declined in the rhizomes and roots until mid July, after which N-concentration increased in the rhizomes. Changes in Phosphoros concentration in the shoots, rhizomes and roots were very similar in pattern to nitrogen. Total non-structural carbohydrate concentration in rhizomes and roots declined until mid July, then began increasing. One wetland was dominated by Potamogeton pectinatus, which reached a peak standing crop biomass of 264 g/m super 2 on August 10. The other wetland had Ceratophyllum demersum and P. berchtoldii as co-dominant species. P. berchtoldii reached a maximum standing crop of 128 g/m super 2 on June 30, while C. demersum peaked at 127 g/m super 2 on July 28.
W84-00050

ACCUMULATION OF CADMIUM IN A FRESHWATER FOOD CHAIN EXPERIMENTAL MODEL,
Metz Univ. (France). Toxicology Lab.
J. F. Ferard, J. M. Jouany, R. Truhaut, and P. Vasseur.
Ecotoxicology and Environmental Safety, Vol 7, No 1, p 43-52, 1983. 8 Fig, 4 Tab, 11 Ref.

Descriptors: *Biological magnification, *Bioaccumulation, *Water pollution effects, Fish, *Daphnia, *Chlorella, *Food chains, Crustaceans, Heavy metals, Cadmium, Metals, Algae, Trophic level.

The study of food chain contamination in the laboratory or in nature requires the precise definition of certain terms. An elaborated version of a freshwater food chain model was applied to assess the hazards of cadmium in the aquatic environment. Chlorella algae were exposed to various levels of cadmium for 10 days in Erlenmeyer flasks and were then fed to the second trophic level of Daphnia magna for 20 days. Leucaspius delineatus comprised the third trophic level of fish, which were allowed to feed on the daphnids for 4 days. Toxicity of cadmium to daphnids was measured in terms of mortality, reproduction and total body levels of the heavy metal. Total cadmium levels were also recorded for algae and fish tissues. Results showed a high direct bioaccumulation of cadmium in algae and an indirect bioaccumulation of the same order of magnitude in daphnids. Although the indirect bioaccumulation of cadmium in fish was much smaller, the transfer of the metal from daphnids to fish was obvious. (Geiger-FRC)
W84-00074

THE SIGNIFICANCE OF THE ACCUMULATION OF CADMIUM BY AQUATIC ORGANISMS,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
D. Taylor.
Ecotoxicology and Environmental Safety, Vol 7, No 1, p 33-42, 1983. 2 Fig, 63 Ref.

Descriptors: *Water pollution effects, *Bioaccumulation, *Cadmium, *Literature review, Crustaceans, Biological magnification, Heavy metals, Metals, Reviews, Mollusks, Gastropods, Aquatic animals.

Cadmium appears on many lists of substances dangerous to aquatic life by virtue of its toxicity at low levels, its persistence and its ability to bioaccumulate. A review of forty laboratory studies on cadmium bioconcentration suggests that the bioaccumulation potential of this heavy metal appears to

have been somewhat exaggerated. Median concentration factors for both marine and freshwater organisms are 100 times; for vertebrate species including fish, concentration factors are 20 times. Bioaccumulation of cadmium by aquatic animals is affected by the speciation of the metal in the aquatic environment, certain abiotic factors such as temperature, salinity, and water hardness, the route of entry of cadmium into the animal, and the action of synergistic and antagonistic substances. There is no evidence in the literature for the biomagnification of cadmium, and the bioconcentration of the metal is only likely to be of significance in a restricted range of gastropod mollusks and some crustacea. (Geiger-FRC)
W84-00075

PRODUCTION OF FILTER-FEEDING TRICHOPTERA IN AN IMPOUNDED AND A FREE-FLOWING RIVER,
Royal Ontario Museum, Toronto. Dept. of Entomology.
For primary bibliographic entry see Field 6G.
W84-00079

TOXICOLOGICAL EFFECTS OF DEHYDROABIETIC ACID (DHAA) ON THE TROUT, SALMO GAIRDNERI RICHARDSON, IN FRESH WATER,
Helsinki Univ. (Finland). Dept. of Zoology.
A. Oikari, B. E. Lonn, M. Castren, T. Nakari, and B. Snickars-Nickinmaa.
Water Research, Vol 17, No 1, p 81-89, January, 1983. 5 Tab, 41 Ref.

Descriptors: *Water pollution effects, *Fish, *Toxicity, *Dehydroabietic acid, Industrial wastes, Effluents, Pulp and Paper industry.

Toxicological and physiological effects of dehydroabietic acid (DHAA), a major poison to fish in pulp and paper mill effluents, were studied by two experiments using rainbow trout, Salmo gairdneri Richardson. In the first experiment fish were acutely exposed for 4 days to an average DHAA concentration of 1.2 mg/liter. In the second the fish were exposed for 30 days to an average of 20 micrograms DHAA per liter. Compared to the controls, fish of experiment 1 displayed a decreased relative weight of liver, increased blood hematocrit, increased hemoglobin, and increased plasma protein concentrations. The aspartate aminotransferase activity of heart muscle was significantly elevated, as was also the lactate dehydrogenase (LDH) of white muscle tissue. In the blood plasma the proportion of muscle-type LDH activity was simultaneously increased. UDP-glucuronyltransferase activities of liver and kidney were strongly decreased. Results suggest an increased and altered use of body energy reserves, decreased plasma volume and impaired liver function. Fish of experiment II showed an increased relative weight of spleen. In addition, liver and gill LDH shifted towards heart-type. It was concluded that 20 micrograms/liter is close to the minimum effective concentration of DHAA for rainbow trout. (Baker-FRC)
W84-00094

THE PERFORMANCE OF A NEW BIOLOGICAL WATER QUALITY SCORE SYSTEM BASED ON MACROINVERTEBRATES OVER A WIDE RANGE OF UNPOLLUTED RUNNING-WATER SITES,
Freshwater Biological Association, Wareham (England). River Lab.
P. D. Armitage, D. Moss, J. F. Wright, and M. T. Furse.
Water Research, Vol 17, No 3, p 333-347, March, 1983. 5 Fig, 8 Tab, 29 Ref.

Descriptors: *Monitoring, *Invertebrates, *Aquatic habitats, Water pollution effects, Water quality, Biological monitoring working party, Species composition, Rivers, Habitats, Macroinvertebrates, Aquatic populations, Classification indexes, Environmental effects.

The Biological Monitoring Working Party (BMWP) system of assigning scores to aquatic habitats was evaluated using macroinvertebrate population data from 268 sites in 41 British rivers varying widely in physical and chemical features. Water quality in the sites was good or fairly good. The BMWP score system ranges from 1, indicating poor water quality, to 10, indicating excellent water quality. Seasonal variation in scores was relatively small, and samples taken in spring, summer, or autumn should give similar average scores per taxon (ASPT), derived from score divided by total number of scoring taxa. Sample replication had little effect on ASPT. Data on BMWP score and ASPT values for 8 groups of sites derived by multivariate classificatory techniques produced considerable variability in achievable score and ASPT. High BMWP scores were most common in the middle reaches; ASPT scores were usually highest in the upper reaches of upland rivers. Shoreline samples had higher scores than midstream samples. ASPT scores also showed differences between sites with similar BMWP scores but different physical and chemical characteristics. Equations for predicting BMWP scores and ASPT were developed to predict theoretical scores for given physical, chemical, and environmental conditions. These equations explained 65% and 22% of the variance for ASPT and BMWP scores, respectively. (Cassar-FRC)
W84-00130

EXPERIMENTAL ESTIMATE OF THE TOXICITY OF DANUBE WATER FOR DAPHNIA MAGNA STRAUS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
E. P. Shcherban.
Hydrobiological Journal, Vol 18, No 2, p 81-87, 1982. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Rivers, *Toxicity, *Turbidity, Pollutant identification, Suspended sediments, Danube River, Daphnia magna, Water quality, Monitoring, Water management, *USSR.

Toxicity of Danube water was studied in both acute and chronic experiments of Daphnia magna Straus. No acute toxicity was observed during the study. When the water was exchanged, death of the crustaceans may have been due to a lack of adaptation to turbid Danube water. During certain periods a sharp increase was noted in toxicity of Danube water, indicating nonuniformity of the influx of toxicants and peaks of pollution. The chronic effect of native Danube water leads to a reduction in the duration of life of the daphnia, a lengthening of their post-embryonal development, and a decrease in the fecundity of daphnia over several generations. The toxicity of Danube water apparently results from the presence of impurities, turbid suspensions, as well as certain toxicants. (Baker-FRC)
W84-00145

SANITARY MICROBIOLOGIC EVALUATION OF THE QUALITY OF COASTAL MARINE WATERS POLLUTED BY INDUSTRIAL AND DOMESTIC WASTES (OSOBENNOSU SANITARNO-MIKROBIOLOGESKOI OTSENKI KACHESTVA PRIBREZHNYKH MORSKOI VOD V USLOVIYAKHI IKH PROMYSHLENNO-BYTOVOGO ZAGRYAZNENIYA),
Institute of General and Municipal Hygiene, Moscow (USSR).
G. A. Bagdasarian, Yu. G. Talaeva, T. Z. Artemova, and A. E. Nedachin.
Gigiena i Sanitariia, No 8, p 5-8, August, 1980. 5 Ref.

Descriptors: *Marine environment, *Microorganisms, *Bioindicators, *Water pollution, Marine biology, Microbiological studies, Viruses, Epidemiology, Seawater, Water pollution effects, *USSR.

Interactions between biological (microbial) and chemical contaminants in marine waters as well as survival patterns of pathogenic and sanitary indicator microorganisms in these waters were studied. The quantitative relationships established in field studies between indicator microorganisms and isolation rates of pathogens of bacterial and viral origin from marine waters made it possible to determine precisely the permissible levels of indicator microorganisms. Indicator organisms characterize the degree of epidemiologic safety of the waters polluted by industrial and domestic sources. (Author's abstract)
W84-00149

EFFECTS OF OIL ON PHYTOPLANKTON METABOLISM IN NATURAL AND EXPERIMENTAL ESTUARINE PONDS,
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
A. A. De la Cruz.
Marine Environmental Research, Vol 7, No 4, p 257-263, 1982. 2 Tab, 16 Ref.

Descriptors: *Phytoplankton, *Oil spills, *Estuaries, Water pollution effects, Aquatic plants, Metabolism, Oil pollution, Oil, *Mississippi, *Marsh ponds, Ocean Springs, St. Louis Bay.

A low level oil spill was simulated in small shallow natural estuarine marsh ponds in Ocean Springs and in experimental impoundments near St. Louis Bay, Mississippi. The oil used in the study was Empire Mix crude oil. It is a low sulfur oil and typifies the type of oil pumped along the US Gulf Coast. A simulated spillage of 1.45 mg per liter of water was made. Within 2 hr after the spill the pond was completely covered by oil. After 5 days the oil on the surface had dissipated but was concentrated along the bank, on the mud and on the marsh plants. On day 1 after the spill the oil concentration was shown by gas chromatographic analysis of pond water to be 33 mg/liter, but this quickly dissipated to about 1.5 mg/liter after 2 weeks. Primary production in the phytoplankton community 2 weeks after the spill occurred revealed a 44 to 65% reduction and 30-50% reduction in respiration. Two months after the spill, primary productivity and respiration in the oiled pond were only 17% and 7% lower, respectively, than in the control pond. In the experimental impoundments at a concentration of 0.2 mg Arabian Empire Mix and Nigerian oil per liter of water in situ radiocarbon uptake by phytoplankton was lower than that of the control pond. One or two months later primary productivity was significantly higher in the Nigerian and Arabian oil ponds than in control and Empire Mix ponds. The changes in plankton metabolism in both natural ponds and impoundments were evaluated on the basis of data simultaneously obtained from adjoining control ponds. (Baker-FRC)
W84-00151

IMPACT OF POLLUTION ON ZOOPLANKTON COMMUNITIES IN THE MARSEILLES DOMESTIC SEWAGE DISCHARGE ZONE. (IMPACT DE LA POLLUTION SUR LES COMMUNAUTES ZOOPLANCTONIQUES DANS LA ZONE D'EPANDAGE DE L'EMISSAIRE URBAIN DE MARSEILLE),
Centre Univ. de Luminy, Marseille (France). Lab. d'Hydrobiologie Marine.
G. Champalbert, and G. Patriti.
Hydrobiologia, Vol 89, No 1, p 17-27, April, 1982. 10 Fig, 1 Tab, 19 Ref.

Descriptors: *Water pollution effects, *Wastewater outfall, *Zooplankton, Municipal wastewater, Population density, Aquatic populations, Marseilles, *France, Mediterranean Sea.

Marseilles, France, discharges domestic wastewater into the Mediterranean Sea. Zooplankton populations have been studied in the polluted area situated near the sewage outlet. Samples were collected along a transect following the course of a float cast off close to the outlet. Three zones, corresponding to decreasing pollution, appeared in the zooplankton populations. In the first zone, which was the most polluted zone and extended for about 500 meters from the outlet, a few tolerant species were abundant, including Acartia clausi, Oithona helgolandica, and Oikopleura sp. In the intermediate zone, which extended for a few kilometers, the densitites of some of the less tolerant species increased, including Paracalanus parvus, Clausocalanus sp., Centropages typicus, Oncaeidae, and Corycaeidae. A third zone, extending for

several kilometers, which may be subject to partial pollution due to residual polluted patches of water, contained tyically neritic populations. (Author's abstract)
W84-00157

AN ASSESSMENT OF MARINE POLLUTION IN PUGET SOUND,
National Oceanic and Atmospheric Administration, Seattle, WA. Office of Marine Pollution Assessment.
For primary bibliographic entry see Field 5B.
W84-00159

THE EFFECTS OF LOW LEVEL TURBIDITY ON FISH AND THEIR HABITAT,
North Carolina State Univ. at Raleigh. Dept. of Zoology.
J. P. Reed, J. M. Miller, D. F. Pence, and B. Schaich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113646, Price codes: A04 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Report No 190, August 1983. 50 p, 8 Fig, 6 Tab, 48 Ref. OWRT B-132-NC(1), 14-34-0001-0237.

Descriptors: *Turbidity, *Fish populations, *Aquatic habitats, Ponds, *Water temperature, Water depth, Dissolved oxygen, *Suspended solids, Suspended sediments, *Light penetration, Aquatic plants, Plant populations, Chara, *Cyanophyta, Submerged plants, Fish food organisms, Productivity, Primary productivity, Chlorophyll A, Epilimnion, Secchi disks, Mathematical models, North Carolina, Raleigh.

The effects of low level turbidity on fish habitat were investigated in a pond near Raleigh, NC. Three levels of turbidity were maintained in polyvinylchloride curtain enclosures with open bottoms each of which enclosed 260-400 m super 2 and had a maximum depth of 2 m. Turbidity levels in the pond routinely ranged from 6 to 50 NTU turbidity units with peaks associated with blue-green algal blooms in excess of 120 NTU. Total suspended solids, TSS, explained 68% of the variability associated with turbidity: a 10 mg/1 increase in TSS increased turbidity 6 NTU units. Turbidity directly affected light penetration. As light penetration decreases, the light energy is transformed into heat over a shorter distance and higher epilimnetic temperatures may result. The magnitude of the temperature change increases as the turbidity increases and/or depth of the epilimnion decreases. For an epilimnion depth of 0.25 m, temperatures in the turbid enclosure (28 NTU) were 2-5C higher than the cleared enclosure (14 NTU). However, at the 'normal' epilimnion depth of 1 m, large increases in turbidity resulted in only small temperature increases. Turbidity also had an effect on submerged macrophytes. A reduction from 12 NTU to 6 NTU enabled them, due to the increased available light, to colonize deeper waters. This increase in plant biomass would result in increased invertebrate prey and therefore higher fish production.
W84-00162

EUTROPHY IN LAKE ACULEO, CHILE,
Chile Univ., Santiago. Dept. of Cell Biology and Genetics
S. S. Cabrera, and V. B. Montecino.
Plant and Soil, Vol 67, No 1-3, p 377-387, 1982. 3 Fig, 7 Tab, 12 Ref.

Descriptors: *Eutrophication, *Lakes, *Productivity, Eutrophic lakes, Lake Aculeo, *Chile, Water pollution effects, Nutrients, Nitrogen, Carbon cycle, Primary productivity, Chlorophyll a, Phytoplankton, Algae.

Nitrogen turnover was studied in Lake Aculeo, near Santiago, Chile, a highly eutrophic body of 7 m maximum depth, 4.4 m mean depth, and 5.8 km length. Concentrations of chlorophyll a varied from 487 mg per cu m at 0.6 m depth in January 1981 to 28.4 mg per cu m at 1.0 m depth in September 1980. Primary productivity fluctuated between 578 + or - 24.8 mg C per cu m per hour on the surface in November 1978 to 3.8 + or - 0.9 mg C per cu m per hour at 2.5 m depth in November 1980. Carbon fixation varied from 157,000 kg C per month in June to 1.34 million kg C per month in December for a yearly total of 6.25 million kg C. Nitrogen turnover, based on a C:N ratio of 6:1, was 1.04 million kg N per year. Nutrients from untreated wastewater and agricultural runoff contribute to the eutrophic condition. (Cassar-FRC)
W84-00172

EFFECTS OF TEMPERATURE AND COLOR COMPONENTS OF WASTEWATER DISCHARGES ON AQUATIC COMMUNITIES,
Westvaco Corp., Covington, VA.
T. G. Botkins, Jr.
Tappi Journal, Vol 66, No 3, p 107-110, March, 1983. 4 Fig, 2 Tab.

Descriptors: *Wastewater disposal, *Water pollution effects, *Pulp and paper industry, Industrial wastes, Aquatic life, Fish, Thermal pollution, Effluents, Bioassays, *Virginia, Jackson River.

A thermal discharge demonstration study was conducted to evaluate the effects of temperature and color components of Westvaco's bleached kraft and semi-chemical pulp and paper mill discharges on aquatic communities in the Jackson River. The study included the development of a longitudinal, time-dependent, thermo-hydraulic model to simulate river flows and temperatures after the dam becomes operational, which is being constructed to reduce the extremes of high and low flow of the Jackson River; an evaluation of the thermal tolerance limits of representative, important species of fish and supportive trophic levels relative to anticipated elevations in river temperatures downstream of the mill; and the execution of temperature/color bioassays to assess the joint effect of these factors on a locally important game fish. It was concluded that the discharge of heat and color by the continued operation of the mill will not cause an imbalance of the indigenous aquatic communities in the Jackson River below the mill. (Baker-FRC)
W84-00177

HEALTH STATUS OF THE POPULATION IN RELATION TO THE USE OF SLIGHTLY MINERALIZED SOFT DRINKING WATER (SOSTOYANIE ZDOROV'YA NASELENIYA V SVYAZI S ISPOL'ZOVANIEM MYAGKIKH MALOMINERALIZOVANNIKH VOD DLYA PIT'YA),
Nauchno-Issledovatel'skii Inst. Gigieny, Moscow (USSR).
Yu. V. Novikov, S. I. Plitman, A. I. Levin, N. U. Shniger, and T. N. Yershova.
Gigiena i Sanitariia, No 12, p 3-6, December, 1980. 3 Tab, 10 Ref.

Descriptors: *Drinking water, *Toxicity, *Water quality standards, Water softening, Minerals, Calcium, Trace metals, Public health.

Morbidity rates and the results of medical examinations were analyzed and a questionnaire survey was conducted in an effort to assess the health status of the population of a Far Eastern region of the USSR where the drinking water is the slightly mineralized soft water characteristic of the Far East. This water is low in minerals (50 to 70 milligrams per liter), has a low hardness (0.8 to 2.0 milligrams-equivalent per liter), has low levels of calcium (2 to 15 milligrams per liter) and magnesium (2 to 10 milligrams per liter), and is deficient in fluorine (0.2 to 0.3 milligrams per liter), while containing lead, arsenic, cobalt, silver, and molybdenum ions. It has been determined that the water has selective actions on the gastrointestinal tract, urinary organs, bony tissue, and the cardiovascular system, and that diseases of the endocrine and nervous systems and of sense organs are more prevalent in the region under study than elsewhere in USSR. The results of these studies have been confirmed and supplemented by the results of a toxicologic experiment on white rats. White rats given the same water had a skin with reduced bactericidal activity and showed a tendency to impaired lipid and mineral metabolism and thyroid hyperfunction. These findings may be of value i predicting the health status of a community and i developing remedial and preventive measure They may also serve as criteria in establishin revised hygienic standards for drinking water. (Au thor's abstract)
W84-00293

ON HYGIENIC STANDARDS FOR COPPER I DRINKING WATER (K NORMIROVANIYU MEDI V PIT'EVOI VODE),
Institut Gigieny Truda i Profzabolevanii, Sverd lovsk (USSR).
V. G. Nadeenko, E. A. Borzunova, K. P. Selyankina, V. G. Lenchenko, and N. N. Petrova.
Gigiena i Sanitariia, No 3, p 8-10, March, 1980. Tab, 1 Ref.

Descriptors: *Drinking water, *Copper, *Wate quality standards, Heavy metals, Toxicity, Embry onic growth stage, Public health.

When ingested in drinking water where it i present at the level of the existing maximum allow able concentration, copper has an adverse effect o pregnancy. Embryotoxic effects of copper ar manifested in high embryonal mortality and im pairment of ossification processes. It is suggeste that the metal may have a toxic action on the fetu through the maternal organism. The embryotoxi effects are believed to result from alteration caused by copper in the metabolic processes in se cells and in biotransformation of trace elements i the placenta and fetus. It is recommended that th maximum allowable concentration for copper i drinking water be set at a lower level of 0. milligrams per liter on the basis of these toxicologi cal effects. (Author's abstract)
W84-00294

RESULTS OF TOXIC ACTION OF WATER POLLUTANTS ON DAPHNIA MAGNA STRAUS TESTED BY AN IMPROVED STANDARDIZED PROCEDURE (ERGEBNISSE DER SCHADWIRKUNG WASSERGEFAHRDENDER STOFFE GEGEN DAPHNIA MAGNA IN EINEM WEITERENTWICKELTEN STANDARDISIERTEN TESTVERFAHREN),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 7B.
W84-00325

FACTEURS RESPONSABLES DE LA DISTRIBUTION DES GASTEROPODES DULCICOLES DANS LE FLEUVE SAINT-LAURENT (FACTORS GOVERNING THE DISTRIBUTION OF FRESHWATER GASTROPODS IN THE ST. LAWRENCE),
Quebec Univ., Montreal. Centre de Recherche en Sciences de l'Environnement.
A. Lamarche, P. Legendre, and A. Chodorowski.
Hydrobiologia, Vol 89, No 1, p 61-76, April, 1982. 5 Fig, 5 Tab, 36 Ref.

Descriptors: *Water quality, *Water pollution effects, *Benthos, Snails, Saint Lawrence River, Hydrocarbons, Organic compounds, Prosobranchs, Pulmonates, Vegetation.

Freshwater gastropod samples were taken from the Saint Lawrence River near Montreal. The samples were studied in an attempt to characterize the populations living in the benthos and on the vegetation, and in order to define the effects of deteriorating water quality on the aquatic life. A total of 98 samples were collected simultaneously from benthos and macrophytes; populations were expressed as the log of each species' relative abundance. Clustering, principal coordinates and discriminant analyses were used to describe and characterize differences between samples. Diversity was also computed to show the transformations of population structure due to differences in pollution levels. Benthic populations were dominated by prosobranch snails, while pulmonates characterized the vegetation inhabitants. The number of species decreased in response to increasing pollution levels on both types of substrates. High hydrocarbon levels were related to a decrease in the

diversity of snail populations on the vegetation only. A differential dependence of prosobranchs in the benthos and of epiphytic pulmonates on the aquatic medium explains the predominance of each species of snails on each substrate. Modes of nutrition were significant factors. Sporadic oil spills affected the snail populations living on macrophytes. (Baker-FRC)
W84-00339

5D. Waste Treatment Processes

THE APPLICATION OF KAOLIN FOR CONTROL OF HEAVY METALS IN ANAEROBIC SLUDGE DIGESTION,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
W. H. Cross, and P. M. Rossello.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110766, Price codes: A04 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 11-83, Georgia Inst. of Technology, Atlanta, August 1983. 43 p, 2 Tab, 16 Fig, 23 Ref. OWRT A-092-GA(1), 14-34-0001-1111.

Descriptors: *Anaerobic digestion, *Heavy metals, *Isotherms, Kaolin, *Kaolinite, *Wastewater treatment, Nickel, Copper, Chromium, Zinc.

Six laboratory-scale anaerobic digesters were used to evaluate the potential of kaolin addition for the control of heavy metal toxicity. Adsorption isotherms were obtained for the kaolin-metal system in solutions of the individual metals, nickel, copper, chromium and zinc and in mixtures of the metals. The adsorption-ion exchange capacity of kaolin for the metals decreased in the order Cr(III) > Cu > Ni > ZN. The performance of digesters containing kaolin only, metals only and kaolin and metals was compared to that of a control to which no metals or kaolin were added. The sludge used was obtained from a local secondary activated sludge sewage treatment plant. Kaolin was fed at a concentration of 1,00 mg/l and the metals content in the feed were increased in every digester and throughout the digesters. The addition of kaolin did not have effect on performance in the non-metals fed digester as compared to the control. However, the presence of kaolin in the metals fed digesters appeared to afford a means of minimizing inhibition by the heavy-metals. The kaolin fed digesters became acclimated to slightly higher concentrations of metals than the non-kaolin fed unit and performed nearly as well as the non-metals fed digesters.
W84-00003

FEASIBILITY AND EFFECTS OF WATER QUALITY ON BAIT-FISH CULTURE IN AERATED SEWAGE TREATMENT LAGOONS IN VERMONT,
Vermont Univ., Burlington.
For primary bibliographic entry see Field 5C.
W84-00006

PROPERTIES AND LONG-TERM BEHAVIOR OF ION EXCHANGE MEMBRANES,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie.
For primary bibliographic entry see Field 3A.
W84-00059

ULTRAFILTRATION PROCESSES FOR POLLUTION CONTROL AND CHEMICAL REUSE IN THE TANNING INDUSTRY,
Naples Univ. (Italy). Facolta di Ingegneria.
For primary bibliographic entry see Field 3A.
W84-00062

ELECTRODIALYSIS IN THE REGENERATION OF PAPER MILL SPENT LIQUOR,
Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
K. Radhamohan, and S. Basu.
Desalination, Vol 33, No 2, p 185-200, May, 1980. 12 Fig, 21 Ref.

Descriptors: Desalination, Desalination processes, Regeneration, Environmental pollution abatement, *Electrodialysis, Product recovery, Electromembrane process, Soda, Lignin, Black liquor.

Experiments have been carried out on the electrodialytic regeneration of soda and lignin from alkaline black liquor with the abatement of environmental pollution for a smaller capacity rice straw-based pulping plant. To predict the performance capability of the system, the hydrodynamic characteristics of a multi-compartment electrodialysis cell have been correlated with the polarizing parameters in three simplified equations. For efficient and economical recovery of soda along with lignin, a two stage electromembrane process, consisting of conventional ED with a -C-N-C-N-C arrangement, followed by an electrogravitational technique is recommended.
W84-00066

BOD REMOVAL EFFICIENCIES IN TWO STABILIZATION LAGOONS IN SERIES IN MALAYSIA,
Engineering-Science, Inc., Arcadia, CA.
R. M. Bradley.
Water Pollution Control, Vol 82, No 1, p 114-122, January, 1983. 5 Fig, 1 Tab, 26 Ref.

Descriptors: *Lagoons, *Wastewater lagoons, *Biological oxygen demand, Wastewater treatment, Stabilization lagoons, Wardieburn, *Malaysia.

Average BOD removal efficiencies in the stabilization lagoon system in Wardieburn, Malaysia, averaged 79% from 1975 to 1980; suspended solids removal efficiencies averaged 50%. This two-lagoon system, about 1 ha in total area and 1.4 m operating depth, was designed to serve 8000 people. The BOD effluent standard of 50 mg per liter as attained in all but one year. BOD removal in the primary lagoon was 62-70%; in the secondary lagoon, 26-49%. Fluctuations in suspended solids removal, 26-52% in the primary lagoon and 1-31% in the secondary lagoon, were attributed to algal growth. Algal biomass contributed about 11% of the BOD in the primary lagoon effluent and 50-60% of the BOD in the secondary effluent. This lagoon was classified as facultative for most of the time. Although the surface aerobic layer is thin on occasion, the lagoon is not anaerobic. However, the current BOD loading on the primary lagoon is approaching the maximum level recommended for a facultative lagoon at 29C. Equations are given for calculating a real BOD removal from the primary lagoon, secondary lagoon, and the two lagoons in series. Maximum BOD removal efficiency can be achieved by having a larger surface area on the primary lagoon than on the secondary lagoon, thus maximizing the BOD load on each lagoon. (Cassar-FRC)
W84-00091

MEASUREMENT OF THE PERFORMANCE OF SEWERAGE SYSTEMS AND ASSOCIATED HYDRAULIC STRUCTURES--RECENT DEVELOPMENTS,
Severn-Trent Water Authority (England). Avon Div.
A. J. Baughen, and A. R. Eadon.
Water Pollution Control, Vol 82, No 1, p 77-86, January, 1983.

Descriptors: *Sewer systems, *Flow measurement, *Performance evaluation, Monitoring, Gages, Measuring instruments, *Wastewater treatment.

Monitoring devices for sewage systems are described. Flow measurement is possible with hydraulic devices (flumes, notches, and weirs), chemical dilution tests, velocity and depth measurements, and electromagnetic gages. Sewage level can be measured by many types of gages, ultrasonic gages being especially in favor. Pumping rates may be monitored by calculation from hours run and the design curves, magnetic flowmeters, ultrasonic gages, and Doppler meters. It is also important to monitor ancillary information such as river levels, water table levels, and soil moisture deficit. Instrumentation in use at the Avon Division, Severn-Trent Water Authority, is described. Doppler meters, Arkon bubblers, ultrasonic gages, fiberglass flumes, the Manning Dipper, and level recorders are examples. Future developments include 6-channel recorders, rolling barrel information storage, and computer storage of information. (Cassar-FRC)
W84-00092

THE USE OF PERFORMANCE INDICATORS IN SEWAGE TREATMENT APPRAISAL,
Yorkshire Water Authority (England). Southern Div.
H. B. Tench.
Water Pollution Control, Vol 82, No 1, p 61-76, January, 1983. 7 Fig, 8 Tab.

Descriptors: *Performance evaluation, *Costs, *Wastewater treatment, Yorkshire Water Authority, Operating costs, *England.

The Yorkshire Water Authority developed performance indicators for use in its wastewater treatment plants. These are divided into resource utilization indicators (financial costs, physical parameters, trade effluent, and comparison of population costs), intended to provide information on the cost structures, and works performance indicators (COD removal, etc.), to give information on the standard of service supplied. An evaluation for three areas in the Southern Division of the Yorkshire Water Authority showed that from 1978-79 to 1979-80 operating costs rose by 39% while inflation for resources used rose by 47%. Use of indicators clearly reflected the Rother area's commissioning of a new works, the relatively high operating costs of filter pressing and incineration of sludge combined with a decrease in volume of trade effluent in the Don area, and the low operating costs at Dearne, which uses percolating filters and disposal of liquid sludge to land. (Cassar-FRC)
W84-00093

SOLVING A DIFFICULT SEWER REHABILITATION PROBLEM,
Park Ridge City Engineer's Office, IL.
J. H. Utz.
Public Works, Vol 114, No 3, p 59-60, March, 1983.

Descriptors: *Sewer systems, *Liners, *Rehabilitation, Pipes, Excavation, Environmental effects, *Illinois, Park Ridge.

A badly deteriorated sewer, 21 inches in diameter and 371 ft long, was located under 5 large, healthy elm trees in a residential section of Park Ridge, Illinois. To avoid damage to the trees by conventional excavation, the sewer was rehabilitated with a polyester felt liner impregnated with a liquid thermosetting resin. The liner was installed with an inversion tube and water pressure, which turned the liner inside out and forced it into the pipe. When the liner was in place, the water was heated and recirculated to harden the resin. Installation and curing of the liner took 15 hours. Service to all affected individual homes was restored within 36 hours of starting the installation. Although some excavation was necessary to repair two small sections of sewer and to connect-disconnect some of the service lines, trees and paving were not greatly disturbed. (Cassar-FRC)
W84-00118

TREATMENT PLANT HAS PARK-LIKE SETTING,
Burgess and Niple Ltd., Columbus, OH.
P. M. Shepard, Jr.
Public Works, Vol 114, No 3, p 75-76, March, 1983.

Descriptors: *Parks, *Aesthetics, *Landscaping, Wastewater treatment facilities, Delaware County, *Ohio, Olentangy Environmental Center.

The Olentangy Environmental Control Center, as the new Delaware County, Ohio, wastewater treatment plant is called, was designed to masquerade as a park to avoid detracting from the Highbanks Metro Park across the river. The planners

took special care to minimize noise and odor. The plant contains lawns, extensive landscaping, buildings with cedar siding and shaked roofs, pergola-covered walkways, gazebos, ponds, a split rail fence, and a 30 ft fountain. Aeration tanks, aerobic digesters, and clarifiers are below ground level. About $1.5 million was spent for the esthetic improvements. (Cassar-FRC)
W84-00119

LAND APPLICATION: A NEW APPROACH TO PLANT EFFLUENT TREATMENT,
Law Engineering Testing Co., Marietta, GA.
G. L. Taylor, L. A. Neal, and N. Dee.
Pulp and Paper, Vol 57, No 3, p 81-84, March, 1983. 3 Fig, 9 Ref.

Descriptors: *Pulp and paper industry, *Land application, *Industrial wastewater, Pulp wastes, *Wastewater treatment, Wastewater irrigation, Irrigation, Color removal, Spray irrigation, Lagoons, Wastewater lagoons.

Land treatment of pulp and paper mill effluents is an alternative to traditional methods of waste treatment. Among the advantages of land treatment are elimination of the need for locating new mills on rivers and reduction of waste discharge into rivers. Effluents currently being treated in this manner are sulfite, kraft, groundwood, strawboard, hardboard and insulation, boxboard and paperboard, deinking, and recycling plant types. Four major techniques of waste application, which may also be combined to fit a particular site, are rapid infiltration in a series of shallow lagoons, overland flow (usually down a 2-4% slope), spray irrigation (the most versatile), and soil incorporation (shallow injection or plowing of wastes into soil). Calculation of the assimilative capacity of a site is difficult and depends on many factors, including the soil and groundwater properties. Land treatment is particularly effective for reducing color in effluents. Lignin, which is responsible for most of the color in pulp mill effluents, is readily degraded by soil microbes. (Cassar-FRC)
W84-00122

A PILOT-SCALE PERCOLATING FILTER FOR USE IN SEWAGE TREATMENT STUDIES,
Trinity Coll., Dublin (Ireland).
N. F. Gray, and M. A. Learner.
Water Research, Vol 17, No 3, p 249-253, March, 1983. 5 Fig, 14 Ref.

Descriptors: *Pilot plants, *Filters, *Wastewater treatment plants, Sampling, Monitoring, Percolating filters.

A pilot-scale percolating filter, easily constructed from materials available in a storeroom or at a sewage works site, is described. It consists of three stacked reinforced concrete manhole sections supported on a concrete block-reinforced concrete base. The medium is supported on a steel grid resting inside the concrete blocks. Sampling and monitoring facilities are built in. This apparatus is easily modified, versatile, low in cost, and adaptable to a wide range of research, evaluation, and development work. (Cassar-FRC)
W84-00123

SIMULTANEOUS ELECTROFLOTATION AND DISINFECTION OF SEWAGE (ELECTROFLOTTATION ET DESINFECTION SIMULTANEE D'EAUX RESIDUAIRES URBAINES),
Electricite de France, Chatou. Direction des Etudes et Recherches.
P. Costaz, J. Miquel, and M. Reinbold.
Water Research, Vol 17, No 3, p 255-262, March, 1983. 9 Fig, 5 Tab, 9 Ref.

Descriptors: *Disinfection, *Oxidation, *Chlorination, Flotation, Electroflotation, *Wastewater treatment, Wastewater oxidation, Flocculation, Activated sludge process.

Simultaneous electroflotation and disinfection of wastewater was studied on the pilot-plant scale. Chlorine and oxygen were generated from chloride ion, the amount depending on current density (100, 200, and 300 A per sq m), COD, chloride concentration (300 to 3000 mg per liter), and oxidation potential of the effluent. Effluent had been pretreated with ferric chloride and an organic polymer. Solid-liquid separation was improved compared to that achieved by static clarification for 2 hours, and the disinfection efficiency was equal to or better than that obtained with gaseous chlorine. For example, at a 900 mg per liter chloride concentration and the three current densities tested, a quantity of 47 million coliforms per 100 ml in the effluent was reduced to 0-1400 per 100 ml. The process produced highly concentrated sludges, suitable for recycling in the activated sludge process. (Cassar-FRC)
W84-00125

EFFECT OF TEMPERATURE AND PH VALUE ON THE GROWTH-RATE CONSTANTS OF NITRIFYING BACTERIA IN THE ACTIVATED SLUDGE PROCESS,
Water Research Centre, Stevenage (England).
H. A. Painter, and J. E. Loveless.
Water Research, Vol 17, No 3, p 237-248, March, 1983. 5 Fig, 6 Tab, 14 Ref.

Descriptors: *Nitrification, *Activated sludge process, *Kinetics, Bacteria, *Wastewater treatment, Temperature effects, Hydrogen ion concentration, Growth rates.

The specific growth rates of nitrifying bacteria were determined under nonequilibrium conditions in a laboratory-scale activated sludge plant at three temperatures (16, 20, and 25C) and over a pH range of 6.0 to 8.5. Generally, nitrification began soon after the beginning of the experiment. However, no nitrification occurred at pH 6.0. For most experiments a pH range of 7.5-8.0 was optimum, with a gradual decrease in rate constant on each side of optimum. There was no apparent pattern in the effects of temperature on nitrification. Undiluted and stale sewage produced higher doubling times than dilute sewage. The reason for this was probably a lower concentration of toxic, inhibitory substances in the dilute sewage. The onset of nitrification was more positive with diluted sewage than with stale or undiluted sewage. Addition of ammonium carbonate lowered doubling times slightly. Growth rate constants at 20C, pH 7.5, were 0.10-0.42 per day for Nitrosomonas in activated sludge grown on domestic sewage. In about half the cases the rate constant for Nitrosomonas was greater than that for Nitrobacter. (Cassar-FRC)
W84-00126

HOW THE ROCKY MOUNTAIN ARSENAL IS HANDLING GROUNDWATER CONTAMINATION,
Rubel and Hager, Inc., Tucson, AZ.
D. B. Hager, and C. G. Loven.
Water/Engineering and Management, Vol 130, No 3, p 18-19, March, 1983. 1 Tab.

Descriptors: *Groundwater pollution, *Chemical wastes, *Activated carbon, Adsorption, Rocky Mountain Arsenal, Denver, *Colorado, Water pollution control, Injection wells, Organic compounds, *Wastewater treatment.

Groundwater contaminated with inorganic and organic chemical wastes from the operations at the Rocky Mountain Arsenal, Colorado, has been contained by slurry wall and hydraulic barriers and by treatment of water with a counter-current granular activated carbon adsorption system. Several dewatering and reinjection wells were installed as part of the activated carbon system. Diisomethylphosphonate was found in highest concentrations, maximum 1130 micrograms per liter. Other chemicals of particular concern were dicyclopentadiene, dibromodichloropropane, and pesticides. Monitoring of treated water quality during 1982 indicated that levels of these chemicals in treated effluents were below detection limits. (Cassar-FRC)
W84-00133

FACTORS INFLUENCING BIOFOULING OF REVERSE OSMOSIS MEMBRANES AT WATER FACTORY 21: CHEMICAL, MICRO BIOLOGICAL AND ULTRASTRUCTURA CHARACTERIZATION OF THE FOULIN LAYER (VOLUME III-B),
Orange County Water District, Fountain Valley CA.
H. F. Ridgway, D. G. Argo, and B. H. Olson.
Available from the National Technical Informatio Service, Springfield, VA 22161 as PB84-11357(Price codes: A06 in paper copy, A01 in microfiche Final Report, November 1981. 113 p, 30 Fig, 1 Tab, 50 Ref. OWRT C-80159-R(5)(8520).

Descriptors: *Advanced wastewater treatment *Wastewater renovation, *Water reuse, Revers osmosis, Microbial fouling, Biofilm composition Fouling bacteria, California, Water Factory 21 Orange County Water District.

Biofouling of cellulose diacetate reverse osmosi (RO) membranes used for dimineralization of mu nicipal wastewater was investigated at Water Fac tory 21, a 0.66 m3/sec (15mgd) advanced wastewater reclamation facility located in Fountain Valley, California. The fouling material was primarily organic in composition (at 90% dry wt, and contained 13% to 18% carbohydrate and 15% to 30% protein. The principal inorganic elements detected were chlorine, calcium, phosphorus and sulfur. Electron microscopy revealed that the fouling bacteria were attached within the biofilm via a network of extracellular polymeric fibrils. Substantial concentrations of adenosine 5'-triphosphate were detected in the biofilm, indicating that the fouling bacteria were metabolically active and potentially able to grow and multiply in situ. In addition, the attached fouling bacteria actively accumulated (3H) glucose and were able to reduce p-iodonitrotetrazolium violet dye (INT) to the insoluble INT-formazan complex. Plate counts indicated 4x10 to the fifth power to 5x10 to the sixth power bacteria per cm squared on the feedwater surface of the RO membranes. Presominant genera associated with the feedwater and permeate water surfaces of the RO membranes were identified. Predominant genera associated with the same or related microbial genera were detected in the feedwater supplying the RO facility. Although there was some correlation between the physico-chemical and microbiological properties of the RO feedwater and the membrane fouling layer, the dynamics of this interaction were not investigated.
W84-00135

EVALUATION OF MEMBRANE PROCESSES AND THEIR ROLE IN WASTEWATER RECLAMATION: VOLUME III-A,
Orange County Water District, Fountain Valley, CA.
D. G. Argo, and M. G. Rigby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113588, Price codes: A14 in paper copy, A01 in microfiche. Final Report, November 1981. 252 p, 68 Fig, 78 Tab, 12 Ref, 1 Append. OWRT C-80159-R(8520)(4).

Descriptors: *Advanced wastewater treatment, *Wastewater renovation, *Water reuse, Reverse osmosis, Electrodialysis, Ultrafiltration, Biofilm development, Fouling, Costs, *California, Water Factory 21, Orange County Water District.

Water Factory 21 (WF-21) in Orange County, California, is a 15-mdg advanced wastewater treatment (AWT) plant designed to reclaim biologically treated municipal wastewater for injection into a seawater barrier system. Processes included are lime treatment, air stripping, filtration, activated carbon adsorption, reverse osmosis (RO), and chlorination. This report presents operating data from WF-21 collected during the final year of a three-year project. The effectiveness of each treatment process is presented including RO dimineralization, ultrafiltration, and electrodialysis. The data collected show that the combined processes, including RO, used at WF-21 are capable of producing a very high quality water on a reliable basis. Treatment reduced all contaminants, to levels below national interim primary drinking water regulation maximum contaminant levels. It was found that lime clarified secondary effluent can be used

as feedwater to a RO dimineralizer. This lime/RO process substantially reduces the pretreatment requirements and cost of reclamation. Experiments with new low pressure membranes (250 psi) show great potential for reducing RO costs. The major cost of RO flux decline was formation of an active biofilm on the membrane surface. The cost of AWT at WF-21 is $1,140 per million gallons. The cost of RO demineralization is $836 per million gallons. These costs include all operation and maintenance as well as amortization of capital.
W84-00136

ABATEMENT OF HEAVY METALS IN INDUSTRIAL EFFLUENTS BY A CATALYZED, ELECTROCHEMICAL REMOVAL SCHEME,
North Carolina State Univ. at Raleigh. Dept. of Chemical Engineering.
J. L. Ayres, and P. S. Fedkiw.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113638, Price codes: A04 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Report No 207, August 1983. 71 p, 12 Fig, 6 Tab, 41 Ref. OWRT A-133-NC(1), 14-34-0001-2135.

Descriptors: Water pollution control, *Heavy metals, Water pollution treatment, Electrochemistry, *Industrial wastewater, *Ion-selective electrodes, *Wastewater treatment, Copper, Lead, Iron, Zinc, Nickel.

This report represents the work performed in the first year of a two-year project. An evaluation of lead and copper deposited on a reticulated vitreous carbon (RVC) surface as a catalytic agent for the electrodeposition of Cu(II), Ni(II), Pb(II), and Zn(II) from dilute solutions (10 mg/1) was performed using a flow-through porous electrode reactor. Copper showed a very strong catalytic activity for Zn(II) and Ni(II) electrodeposition at loadings from 20 to 50 ug/cm super 2. The removal efficiency of Cu(II) from a 100 mg/1 solution circulated from a reservoir to a porous, flow-by, uncatalyzed electrode and back to the reservoir was examined. A current efficiency of 87% was measured as the concentration of Cu(II) was lowered from 95.6 ppm to 0.05 ppm. An electrical operating cost of 11 cents per lb. of copper recovered can be estimated from the results. This should be compared to the cost of chemicals required if precipitation is used of 65.3 cents per lb. of copper removed. In addition, the volume of waste generated is considerably lower in the electrolytic route in comparison to precipitation; the volume of precipitation-generated sludge composed of 4% solids is 4.45 gal per lb. of copper as compared to .0279 gal per lb. copper (50 percent of void volume in RVC filled by copper) electrochemically generated.
W84-00161

ANAEROBIC FLUIDIZED BED EXPERIMENTATION WITH A MOLASSES WASTEWATER,
Aktiebolaget Sorigona, Staffanstorp (Sweden).
B. Frostell.
Process Biochemistry, Vol 17, No 6, p 37-40, November/December, 1982. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Anaerobic conditions, *Fluidized beds, *Biological wastewater treatment, *Wastewater treatment, Sand, Industrial wastewater.

A beet molasses wastewater from a baker's yeast factory (COD, 9.1 kg per cu m) was treated in a laboratory scale anaerobic fluidized bed using a sand carrier and external solids recycling. After design changes, stable treatment at 20-25 kg COD was attained. At a loading rate of 22.2 kg COD per cu m per day methane conversion was 43%. Maximum biomass concentration was 22 kg VS per cu m, of which only 13 kg VS per cu m was attached. By the end of the 165-day experiment the solids retention time was 11-13 days. The system tolerated high suspended solids concentrations--average, 11.6 and maximum, 14.0 kg MLTSS per cu m. Startup time necessary to achieve a load of 20 kg COD per cu m per day was long, over 3 months. (Cassar-FRC)
W84-00173

THREE COST EFFECTIVE I/I PROGRAMS.
Public Works, Vol 114, No 1, p 56-57, January, 1983.

Descriptors: *Sewer systems, *Rehabilitation, *Sewer infiltration, Leakage, Grouting, Inspection, Costs, Infiltration, New Jersey, West Virginia, Kansas.

Television inspection and chemical grouting helped three cities to substantially reduce sewer system infiltration/inflow (I/I). Hamilton Township, New Jersey, used a relatively inexpensive TV inspection and sealing unit, which eliminated 90-95% of infiltration and dropped the wastewater flow from 12 to 7 mgd. Not only was the proposed emergency expansion of the treatment plant cancelled, but half of the 16.5 mgd plant was shut down. The inspection unit is also used to view newly built sewer lines before acceptance. In Newport News, Virginia, the I/I was 573% of the actual sewage. TV inspection and smoke testing units, joint sealing chemicals, and associated equipment is being used in a four-year in-house rehabilitation program. Wichita, Kansas, has been running a TV-assisted I/I control program for 12 years. It uses a grout pumping system that can handle a variety of grouts. Although no records of actual I/I reduction have been kept, 53,000 leaking joints have been identified and repaired during the last 9 years. (Cassar-FRC)
W84-00174

THE EFFECT OF CHLORINE DIOXIDE SUBSTITUTION ON BLEACHING EFFLUENT TOX!CITY AND MUTAGENICITY,
C-I-L, Inc., Mississauga (Ontario). Chemicals Research Lab.
G. P. Donnini.
Pulp and Paper Canada, Vol 84, No 3, p 74-78, 80, 1983. 4 Fig, 6 Tab, 38 Ref.

Descriptors: *Chlorine dioxide, *Pulp and paper industry, *Bleaching agents, Wastewater effluents, Kraft mills, Pulp wastes, Mills, Toxicity, Daphnia, Chlorination, Mutagenicity, Wastewater treatment.

Kraft pulps were bleached with various levels of chlorine dioxide substitution in the chlorination stage, and the toxicity and/or mutagenicity of the resulting C and El filtrates, as well as of some combined CED and CEDED effluents, were determined. Low levels (4 and 10%) of chlorine dioxide substitution provided significant reductions in the total Daphnia toxicity of C+El filtrates. High levels of substitution provide additional, but proportionally smaller, decreases in toxicity. The mode of chemical addition and the amount of chemicals applied can effect the toxicity substantially . High chlorine dioxide substitution reduces the mutagenicity of chlorination effluents, but sequential chlorination yields higherr activity than simultaneous addition. The toxicity values of combined CED and CEDED effluents from low and high chlorine dioxide substitution are not substantially different. The toxicity values of the respective C and El filtrates do not accurately predict the toxicity of combined effluents. Dl stage filtrates are acutely toxic and could be responsible for a substantial portion of the toxicity of mill acid bleach effluents. In order to compare realistically the toxic load of bleach plant outfall from low and high chlorine dioxide substitution, the toxicity of combined effluents should be measured. (Baker-FRC)
W84-00195

THE APPLICATION OF THIN FILM COMPOSITE MEMBRANES IN PLATE-AND-FRAME SYSTEMS FOR WATER PURIFICATION,
Danske Sukkerfabrikker, Nakskov. Driftteknisk Lab.
W. K. Nielsen, and S. Kristensen.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 383-396, 5 Fig, 3 Tab, 7 Ref. (1st Vol of Proc. of Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Membranes, Water purification, Hyperfiltration, Thin film composite membranes, Plate-and-frame systems, Pulp and paper industry, Food processing industry, Dairy industry, Whey.

Thin film composite membranes are now at such a level where stable and reliable membranes can be produced on a large scale. Utilization of thin film composite membranes within water desalination and in the dairy industry for concentration of whey is outlined. The application for concentrating waste-water streams in the pulp and paper industry is mentioned. The membrane is developed for water desalination. Temperature resistance is 80C for operation. The membrane can stand cleaning with nitric acid, phosphoric acid, caustic soda, and soda ash. Because of a high salt rejection, the rejection of small organic solutes is excellent. This is of importance to waste waters and dairy and food products. Sanitation and cleaning are improved. High temperature operation makes the process possible in new areas and enables capacity increase. Experience is summarized gained with thin film composite membranes in plate-and-frame systems with special regard to: (1) chemical and temperature stability; (2) influence of elevated temperature on organic low molecular weight substances, such as lactic acid and urea; (4) cleaning and sanitation schemes and experience within a number of different applications; and (5) the prospects of thin film composite membranes for water treatment and in the food and dairy industry.
W84-00240

CHEMICAL TREATMENT FOR REUSE OF WASTEWATER EFFLUENTS IN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
H. A. Kharajian, R. H. Siddiqi, and S. Farooq.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 437-438, 1 Tab (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Water reuse, Wastewater renovation, Reverse osmosis, Lime, Sodium hydroxide, *Desalination, *Wastewater treatment, Dhahran, *Saudi Arabia.

Reclamation of municipal wastewater is receiving increasing attention in Saudi Arabia. In the reclamation process desalination of wastewater becomes necessary when total dissolved solids (TDS) concentration is high. At most locations in Saudi Arabia the TDS of wastewaters ranges between 2000 and 4000 mg/l. A considerable fraction of the dissolved solids is due to salts of divalent cations, magnesium and calcium. Chemical precipitation of these salts would therefore be required as either a single step treatment in the reclamation process or as a preparatory treatment in conjunction with reverse osmosis or electrodialysis. The chemical treatment of raw and biologically treated wastewater at Dhahran was investigated. Lime and sodium hydroxide were used. Both were effective in reduction of TDS and hardness. Some typical preliminary results of treatment of secondary effluent are given.
W84-00246

UTILIZATION OF THE WASTE CONCENTRATED SEAWATER IN THE DESALINATION PLANTS,
Asahi Glass Co. Ltd., Chiba (Japan).
T. Kawahara, and K. Suzuki.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 499-507, 8 Figs, 4 Tab, 2 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Manama, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Electrodialysis, Desalination apparatus, Flash evaporator, Salts, Brines, Water reuse, Salt recovery.

Concentration of waste brine exhausted from flash evaporator was studied with a newly developed concentration technique. The results were that concentration of NaCl in concentrated brine, its purity, electric power consumption and its cost,

respectively, were 264(g/l), 96(%) (NaCl/T.salts) and 238(KWH/t-NaCl). Installation cost was 3,380 million yen and total concentrated brine cost including amortization was 2,760 sub 3(Yen/t-NaCl) under the following design basis. Quantity of waste brine 100,000(m super 3/D), production capacity 610,000(t-NaCl/Year), current density 7(A/dm2), electricity 5(Yen/KWH). Installation cost and operating cost for recovery of salt have been substantially reduced, so electrodialytic concentration process appears more attractive than it has hitherto been the case for the industrial use or manufacturing of table salt.
W84-00252

WATER SOFTENING BY DIFFUSION USING CATION EXCHANGE MEMBRANES,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
B. S. Joshi, and K. P. Govindan.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 509-516, 2 Figs, 5Tab, 7 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Manama, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, *Membrane processes, Water treatment, Water softening, Cation-exchange membranes.

Water softening by an interionic diffusion process across a cation-exchange membrane is studied. A twenty compartment laboratory scale unit with an effective cross-sectional area of 63 sq cm is assembled and studied for water softening using an interpolymer cation exchange membrane developed in this institute. Alternate compartments formed by thin gaskets are fed with synthetic hard waters and sodium chloride as regenerant solution in a counter current series flow arrangement. Results on softening of hard water of 500, 1000, 1500 ppm as CaCO3 containing sodium chloride in the ratios: 1:0, 1:1 and 1:2 are given. The regenerant concentrations of 0.5, 1.0 and 1.5 N are studied for softening efficiency. Diffusion of salt and water through the membranes and the effect of regeneration levels to achieve 80% softening is also investigated. The commercial prospects for a continuous softening system by this method are discussed.
W84-00253

DEMINERALIZATION BY ELECTRODIALYSIS USING AMPHOLYTIC ION-CONDUCTING SPACERS,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
K. P. Govindan, and P. K. Narayanan.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 517-527, 1 Fig, 5 Tab, 7 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Manama, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Electrodialysis, Water treatment, Demineralization, Ion-conducting spacers.

The synthesis of ampholytic ion-conducting spacers and their use in demineralization of low saline waters with cost of treatment are given. The various modifications on the use of conducting spacers in demineralization by electrodialysis are discussed. Extension of the technique in prevention of environmental pollution by recovery of valuable materials and elimination of harmful ions in trace quantities is also described.
W84-00254

OPERATION OF A HORIZONTAL TUBE BRINE CONCENTRATOR,
Israel Desalination Engineering Ltd., Tel-Aviv.
For primary bibliographic entry see Field 3A.
W84-00272

EFFECT OF THE ENERGY CRISIS ON WATER DESALINATION AND WASTE WATER RECYCLING BY ION EXCHANGE,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Div. of Membranes and Ion-Exchangers.
For primary bibliographic entry see Field 3A.
W84-00274

IS MONOD'S APPROACH ADEQUATE FOR THE MODELING OF PURIFICATION PROCESSES USING BIOLOGICAL TREATMENT. (FAUT-IL ABANDONNER LE FORMALISME DE MONOD POUR LA MODELISATION DES PROCESSUS DE DEPOLLUTION PAR VOIE BIOLOGIQUE.),
Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. de Chimie et Genie de l'Environnement.
H. Roques, S. Yue, S. Saipanich, and B. Capdeville.
Water Research, Vol 16, No 6, p 839-847, June, 1982. 7 Fig, 1 Tab, 25 Ref.

Descriptors: *Biological treatment, *Wastewater treatment, *Mathematical studies, Mathematical models, Anaerobic treatment, Fermentation.

Experimental evidence has demonstrated that it is not possible to use Monod's model to express the velocity of purification processes using biological treatment. This is so because it is impossible to estimate the effects of the substrate concentration at the inlet on the substrate concentration at the outlet during a continuous fermentation; to obtain, in certain cases, positive values of the maximum growth rate during graphical determinations using the linearized form of the model; or to estimate the variations of the saturation constant as a function of the sludge age and the biomass fraction in each tank in the contact-stabilization process. A new model, which is drawn from Contois' model, is proposed and the equation for this model is presented and discussed. The proposed model is compatible with a limitation of the growth by accumulating inhibiting metabolites in the culture medium. It also keeps the possibility to characterize the limitation of the culture by exhaustion of the substrate and to take into account the substrate transfer resistance surrounding the microorganism. This formulation is shown to generalize the previous modeling processes by presenting Monod's, Contois's, Powell's, and Elmaleh's classical models as particular cases corresponding to particular values of the constants used. The application of this model to different effluents is demonstrated, and numerical values of the constants used are given. (Carroll-FRC)
W84-00324

LAND APPLICATION OF UNTREATED INDUSTRIAL WASTE WATER,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
L. D. King.
Journal of Environmental Quality, Vol 11, No 4, p 638-644, October-December, 1982. 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Land application, *Wastewater irrigation, *Industrial wastewater, Denitrification, Wastewater disposal, Irrigation, Nitrates, Fate of pollutants, Pulp and paper industry, Heavy metals, Metals, Sodium, Wastewater treatment.

Untreated and treated wastewaters from a fiberboard mill were applied to fescue grass by spray irrigation for 4 years. The wastewaters varied widely in chemical composition over the study period. Initial application rate was 1.4 cm per week. After 2 years the untreated wastewater rate was changed to 1.5, 2.0, and 3.0 cm per week. 20%-30% of applied N was recovered in the harvested crop. Concentrations of Mn, Ni, Pb, and Cr in the unwashed crop were increased slightly, to levels well below the maximum tolerable in forage. Soil nitrate concentrations in untreated wastewater irrigation and control plots were not significantly different, except when the wastewater had very high nitrate levels. By the end of the study total N levels were higher in the 150-210 cm soil level near the surface; highest soil P was 150 ppm (untreated wastewater at highest application rate); highest soil Ca was >4000 ppm (untreated wastewater at 2 cm per week application); highest soil K was 340 ppm (untreated wastewater at highest application rate). Soil Na accumulated in the subsoil 136 ppm. This high concentration was attributed to a Na spill, pointing out the need for an equalization basin in the system. Soil pH was increased by the wastewater treatments to 7.4-7.8. Results showed that extensive pretreatment of wastewater before disposal to land did not significantly improve soil properties as compared with treated wastewater. (Cassar-FRC)
W84-00333

USE OF BIOLOGICAL FILTERS FOR TREATING AGRICULTURAL DRAINAGE EFFLUENTS,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, K. L. Campbell, D. A. Graetz, and K. M. Portier.
Journal of Environmental Quality, Vol 11, No 4, p 591-595, October-December, 1982. 4 Fig, 6 Tab, 19 Ref.

Descriptors: *Nutrient removal, *Aquatic plants, *Agricultural runoff, Wastewater treatment, Nitrates, Phosphates, Ammonium, Nitrogen removal, Phosphorus removal, Macrophytes.

Nutrient removal from agricultural drainage water was studied in a reservoir system containing aquatic macrophytes. The system, located near Lake Apopka, Florida, consisted of three reservoirs in series, each about 1240 cu m in volume, containing water hyacinth in R2, elodea in R3, and cattail in R4. The control reservoir (R5) contained Chara sp. but no macrophytes. Influent water contained 0.2 micrograms nitrate-N per liter, 0.1-1.0 micrograms ammonium-N per liter, 1.5-10.0 micrograms organic N per liter, and up to 2 micrograms per liter total P. Residence times were 3.6 days for R2 alone, 7.2 days for R2-R3, 9.4 days for R2-R3-R4, and 10.9 days for R5, the control. In the R2, R2-R3, R2-R3-R4, and R5 systems, respectively, removals adjusted for seepage losses were: nitrate-N, 81.1%, 91.5%, 92.1%, and 85.0%; ammonium-N, 78.1%, 77.8%, 80.0%, and 62.4%; organic N, 32.0%, 24.0%, 21.7%, and 6.2%; phosphate-P, 54.0%, 71.3%, 84.6%, and 58.5%; and total P, 32.2%, 43.6%, 66.2%, and 6.9%. (Cassar-FRC)
W84-00340

CONTROLLING COOLING TOWER PH AND CYCLES OF CONCENTRATION,
J. R. Hefler.
Industrial Water Engineering, Vol 19, No 3, p 24-28, May/June, 1982. 7 Fig, 7 Ref.

Descriptors: *Cooling towers, *Acidity, *Water treatment, Temperature effects, Humidity, Water quality, Carbon dioxide, Carbonates.

In open recirculation cooling systems the cooling tower pH must be controlled in response to external changes which are not controllable. These external changes include atmospheric temperature, humidity, and pollution levels, and makeup water quality. The most cost-effective operation can only be assured by precise determination of circulating water pH and its cycle of concentration, the two factors that can be controlled. In the acid addition system of control, stable wide-range acid feed is provided. A metering pump is used as the final control element to deliver acid at a rate independent of changes in viscosity, suction lift, or discharge pressure. The acid addition system should be interlocked with the circulating and makeup pump starters so that no acid is fed unless there is flow in the cooling system and the dilution pump is operating. Cooling water pH control is a means of suppressing carbonate ion and offsetting the loss of free carbon dioxide as the heated water is aerated. In addition to the acid addition system and pH control there are also systems for controlling the flow which regulate makeup to keep pace with evaporation and preset blowdown as a ratio of makeup. Cooling water chemistry is still far from being cut and dried. Considerable help can be obtained if the operation of all well instrumented systems were to be analyzed and compared. There are various technical societies which can be helpful in this regard. (Baker-FRC)
W84-00343

5E. Ultimate Disposal Of Wastes

A CASE STUDY OF DRY WELL RECHARGE,
Arizona Water Resources Research Center, Tucson.
L. G. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110865, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September 1983. 55 p, 15 Fig, 13 Tab, 10 Ref. OWRT A-114-ARIZ(1), 14-34-0001-1103.

Descriptors: *Urban runoff, *Waste disposal wells, Water pollution, Vadose water, *Recharge wells, Storm runoff, *Arizona, Tucson.

Five injection tests were conducted on an experimental dry well at a site near Tucson, Arizona. Goals of the tests were to determine (1) intake characteristics of the well, (2) flow patterns in the vadose zone, and (3) attenuation of urban runoff pollutant analogs (metals, microorganisms, and organic matter) in vadose zone/ground-water flow systems. Specific intake rates exceeded specific capacity values at a nearby pumping well. A perched ground-water system and a water table mound were observed by neutron moisture logging with lateral flow velocities averaging 500 ft/day. Metals were detected breaking through in a vadose-zone sampling well. Microbial tracers also arrived at the vadose zone sampling well, but peak values were markedly reduced below input values. The initial concentration of organic matter breaking through in the sampling well was 58% of the input values. No organic matter or microorganisms were detected in pumped ground-water samples. It was generally concluded that (1) dry well injection of urban runoff may develop perched ground water systems capable of spreading injected water within the radius of influence of nearby wells, and (2) given the pollutant loading rates of the test, ground water was not deteriorated in quality.
W84-00013

MAXIMUM APPLICATION RATES FOR LAND TREATMENT OF SEPTAGE,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
C. J. Clanton, R. E. Machmeier, J. L. Anderson, and M. J. Hansel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111806, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Univ. of Minnesota, St. Paul, September 1983. 23 p, 8 Fig, 4 Tab, 12 Ref, 1 Append. OWRT A-045-MINN(2).

Descriptors: *Wastewater, *Septage, *Groundwater, *Land treatment, Soils, Nitrates, Phosphorus, Salts, *Application rates, Wastewater disposal.

Two years of data from a three year study indicates septage application rates of 1120 and 1500 kg/ha of nitrogen resulted in increased concentrations of nitrates in soil water extracts for a Hubbard loamy sand, Waukegan silt loam and Lester clay loam. Nitrate movement is quite slow through the Lester clay loam so that negative impacts of high rates of application will not be as great when compared to the silt loam or loamy sand. However, if the objective is to prevent movement of high concentrations of nitrates through the soils these application rates are too high. The application of septage did not affect the concentrations of fecal streptococcus and fecal coliforms in the soil water when comparing the treated plots for both years. This indicates that the soils evaluated have the capability to reduce the high level of fecal organisms found in septage to levels found normally in soil water. Septage application resulted in a significant increase in concentration of soil water calcium, magnesium, sodium and potassium during the first year. In addition, there was no increase in phosphorus concentration in the soil water.
W84-00040

DESIGN OF SEA OUTFALLS - THE LOWER LIMIT CONCEPT OF INITIAL DILUTION,
N. J. Bennett.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 75, No 1, p 113-131, 1983. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Outfall sewers, *Path of pollutants, *Mathematical studies, *Dye dispersion, *Wastewater disposal, Outfall, Coastal waters, Water currents, Design criteria, Statistical analysis, Tracers, Fate of pollutants, *England, East Sussex River.

A detailed sequel study was carried out by the East Sussex Water and Drainage Division of the Southern Water Authority. The study measured dye-sewage concentrations at the mouth and sea surface at the Hastings long sea outfall after 333 injections of Rhodamine WT dye within a diffuser port over a 3.5 month period. Ambient current, angle of ambient current relative to the diffuser, salinity, temperature and depth measurements were also recorded. Results of mathematical and statistical analyses of collected data showed that the formula derived by the Water Research Center for use in moving water conditions greatly underestimates dilutions and that the use of correction factors as a basis for measuring dilutions in moving water is not substantiated. A simpler, lower limit formula is proposed for use in sea outfall design which may be applied for the measurement of dilutions under a wide range of conditions. (Geiger-FRC)
W84-00076

WASTE-RELATED CADMIUM CYCLE IN SWITZERLAND,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W84-00078

RAYONIER PRODUCES ANIMAL FEED FROM SECONDARY SLUDGE AT SULFITE MILL,
J. C. W. Evans.
Pulp and Paper, Vol 57, No 3, p 124-126, March, 1983. 1 Fig.

Descriptors: *Sludge disposal, *Pulp and paper industry, *Dewatering, Industrial wastes, ITT Rayonier, Feeds, Pulp wastes, Sulfite mills, Carver-Greenfield evaporator, Evaporation, Biological wastewater treatment, Activated sludge process, Wastewater treatment, *Washington.

Sludge from the Rayonier Port Angeles, Washington, sulfite market pulp mill is converted into animal feed. This was the most suitable of 13 alternative sludge dewatering and disposal schemes evaluated. Pilot studies showed that the dry product had a protein content of 41-48% and a heat content of 9000 Btu. In the two-stage dewatering operation, the biomass from the secondary treatment plant is conditioned with polymers prior to belt filtration. The filtrate is returned to the secondary treatment plant, and the filter cake is sent to the second stage, a Carver-Greenfield evaporator system. With this process a metered quantity of oil is added to the sludge and the mixture passed through a series of multiple-effect, falling-film evaporators. Solids remain in the oil as a fluid slurry, which is centrifuged to recover the solids. Oil is recycled. This method of sludge disposal has no negative effects on water quality or the environment. (Cassar-FRC)
W84-00121

COMPOSTING OFFERS ALTERNATIVE FOR EFFLUENT PLANT SLUDGE DISPOSAL,
E and A Consultants, Stoughton, MA.
J. E. Alpert, E. Epstein, and C. De Groot.
Pulp and Paper, Vol 56, No 11, p 127-129, November, 1982. 2 Fig, 2 Tab.

Descriptors: *Sludge disposal, *Pulp wastes, *Composting, Industrial wastes, Aeration.

The Beltsville forced aeration sludge composting process is suitable for pulp and paper mill wastes. Raw sludge is mixed with a bulking agent such as bark or wood chips and piled 8 to 9 ft high over a perforated drainage pipe. A blower draws or blows air through the pile to maintain a desired temperature for the 2-6 week composting period. Finished compost can be sold as a soil conditioner or used by the paper mill itself for reforestation projects, odor scrubbing, or as fuel for boilers. Capital and operating costs for a 10 dry ton per day composting plant are $699,062 and $133,369, respectively. (Cassar-FRC)
W84-00175

SIMULATING LAND APPLICATION SITING EFFECTS ON WATERSHED HYDROLOGY,
Agricultural Research Service, Fresno, CA.
J. E. Ayars, M. Yaramanoglu, and H. N. Holtan.
Transactions of the ASAE, Vol 26, No 1, p 100-105, 1983. 5 Fig, 7 Tab, 5 Ref.

Descriptors: *Wastewater disposal, *Spray irrigation, Irrigation practices, Irrigation, *Land disposal, Waste disposal, Water quality, Hydrologic models, Model studies.

A hydrologic model was used to simulate the effects of land application of treated sewage effluent on the hydrologic response of a watershed. The effect of soil type, soil drainage characteristics and geology was tested on the disposal capacity of a land application system. Also, three conditions were used to initiate an irrigation: soil water was reduced to any value less than saturation; to 65% of available water capacity in the profile; and to 35% of available water capacity. Results demonstrated that base flow in a watershed is an important design parameter and that disposal rates needed to be matched to base flow and evapotranspiration potential. It was also shown that perennial cropping and frequent irrigation have the potential to increase disposal capacity. The study also demonstrated that a hydrologic model is a tool which provides a method to evaluate specific effects of a spray irrigation site on watershed hydrology which cannot be done easily in any other way. (Baker-FRC)
W84-00179

LAND APPLICATION OF UNTREATED INDUSTRIAL WASTE WATER,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 5D.
W84-00333

5F. Water Treatment and Quality Alteration

THE ECOLOGY OF ACID-FAST ORGANISMS IN WATER SUPPLY, TREATMENT, AND DISTRIBUTION SYSTEMS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Hass, M. A. Meyer, and M. S. Paller.
Journal of the American Water Works Association, Vol 75, No 3, p 139-144, March, 1983. 9 Tab, 15 Ref.

Descriptors: *Chlorination, *Microorganisms, *Filtration, Bacteria, *Acid-fast organisms, *Water treatment, Water distribution, Fate of pollutants, Turbidity, Manchester, Concord, *New Hampshire.

Acid-fast organisms were well correlated with total coliforms throughout the Manchester and Concord, New Hampshire, water systems. Water from 8 locations in each system, from raw water to consumer, was sampled and analyzed for these organisms plus plate count, membrane standard plate counts, free and total chlorine residual, total organic carbon, pH, turbidity, and temperature. In raw water densities of acid-fast organisms correlated with concentrations of total coliforms and turbidity level. Acid-fast organisms were largely removed by sand filtration and further decreased in density with increasing distance from the treatment

plant. The acid-fast organisms were relatively resistant to chlorination and actually increased by 22% during chlorination at Concord. (Cassar-FRC)
W84-00022

KINETIC MODEL FOR OZONATION OF TOXIC WATER CONTAMINANTS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
E. P. Minchew, F. M. Saunders, and J. P. Gould.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111889, Price codes: A02 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 13-83, Georgia Inst. of Technology, Atlanta, September 1983. 16 p, 4 Tab, 7 Fig, 16 Ref. OWRT A-095-GA(1), 14-34-0001-1111.

Descriptors: Contamination, *Decomposition, *Kinetics, *Ozonation, *Ozone, Ozone decomposition, Hydrogenion concentration, Model studies.

A laboratory study was conducted on ozone decomposition kinetics in buffered water at various pH values. Ozone decomposition was shown to be highly dependent on pH, contaminant level, ozone concentration and UV irradiation. At pH values of 1.85 and 6.65, the order of the ozone decomposition was shown to be a function of ozone concentration and ranged from third-to zero-order for concentrations of 10 super -8.4 to 10 super -12 M. Accumulation of ozone-decomposition intermediates was shown to significantly effect the rate of ozone decomposition. The results of the study will aid greatly in evaluation of the oxidation of contaminant organics in waters and wastewaters and in determination of the relative rates of contaminant oxidation and ozone self-decomposition.
W84-00048

CONVENTIONAL WATER TREATMENT PROCESS OPERATES IN UNCONVENTIONAL MANNER,
Quicksall (W.E.) and Associates, Inc., New Philadelphia, OH.
J. S. Bachman, and J. R. Morgan.
Public Works, Vol 114, No 3, p 50-53, March, 1983. 2 Fig, 1 Tab.

Descriptors: *Ion exchange, *Water softening, *Brine disposal, Water treatment, New Philadelphia, *Ohio, Tuscarawas River, Manganese, Iron.

The water treatment plant at New Philadelphia, Ohio, is based on a pressure type sodium cycle ion exchange system, with concurrent removal of iron and manganese by pressure type manganese greensand filters. Waste brine regenerate is discharged into the Tuscarawas River. Design studies showed that at full operating capacity the plant would discharge 16,740 pounds of chloride daily into the receiving stream. This discharge would increase chloride concentrations in the river by 2.5 mg per liter at mean river discharge and by 16 mg per liter at low flow. This additional chloride load was acceptable to the Ohio EPA, since an upstream industry discharge raises chloride levels in the river to 450-900 mg per liter. Normal background levels of chloride are 26-30 mg per liter. The process uses split stream softening. About 80% of the flow is softened; the remaining 20% bypasses the softeners and is only treated for Mn and Fe removal. The brine discharge is spread evenly over a 24-hour period. The annual cost (capital amortization and operation/maintenance) is about half of a conventional lime-soda ash treatment plant (estimated at about $1 million for a 5 mgd plant). (Cassar-FRC)
W84-00120

FACTORS INFLUENCING THE ADSORPTION OF BACTERIA TO MAGNETITE IN WATER AND WASTEWATER,
Queensland Univ., Brisbane (Australia). Dept. of Microbiology.
I. C. MacRae, and S. K. Evans.
Water Research, Vol 17, No 3, p 271-277, March, 1983. 5 Fig, 6 Tab, 15 Ref.

Descriptors: *Bacteria, *Adsorption, *Magnetite, Water treatment, Sirofloc process, Wastewater treatment, Calcium, Magnesium, Hardness, Polyelectrolytes.

The interaction of bacteria and magnetite in the Sirofloc water treatment process was investigated. Magnetite particles pretreated with 8 cycles of alternating magnetization and demagnetization were not significantly more effective in removing 5 types of common bacteria than untreated magnetite. At low bacterial levels (10 million CFU per ml) the magnetite concentrations from 0.5-4% produced similar bacterial removals. At higher bacterial levels (665 micrograms per ml dry weight) 1-2% magnetite was required to remove 95% of the cells. Adsorption of bacteria was essentially complete within 10 min. with 1% magnetite in the presence of 11.13 mg per liter Ca and 9.62 mg per liter Mg adsorption of bacteria was 97-99% in the pH range 2.5-10.0. In the absence of Ca and Mg adsorption was 97-99% in the pH range 3-6 and 50% at pH 10. Addition of 0.5% Catoleum 8101 polyelectrolyte improved bacterial adsorption at magnetite concentrations of 0.05% and 0.10% but not at 0.25% and 1%. Bacterial removal from a wastewater effluent (hardness, 180 mg per liter as CaC03) was 70% in the first cycle and 98.1% in the second cycle. In the presence of Ca and Mg desorption of bacteria was very small: E. coli, 0.02%; Streptococus fecalis, 0.33%; Pseudomonas stutzeri, 6.28%. Without Ca and Mg 39.05% of E. coli were desorbed. (Cassar-FRC)
W84-00124

THE STABILITY IN WATER OF A NEW CHLORAMINE DISINFECTANT,
Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, W. B. Wheatley, H. H. Kohl, J. A. Van Hoose, and H. D. Burkett.
Water Resources Bulletin, Vol 19, No 1, p 97-100, February, 1983. 2 Fig, 14 Ref.

Descriptors: *Disinfectants, *Water treatment, *Bacteria, Purification, Stability, *Chloramines, 3-chloro-4,4-dimethyl-2-oxazolidinone, Chlorine.

The stability in water of a novel new chloramine agent, 3-chloro-4,4-dimethyl-2-oxazolidinone (I), has been compared to the stabilities of several other water disinfectants. Agent I proved to be remarkably stable in water solution and in dry storage. It also far exceeds all other agents tested in this work in this respect. Agent I could be termed as a slow release disinfectant which kills bacteria upon demand. Furthermore, its great stability and low percent dissociation to hypochlorous acid should prevent the formation of toxic trihalomethanes in treatment plants. The stability of agent I is certainly a desirable attribute which renders it of potential use as a disinfectant for small water supplies, swimming pools, cooling water for power plants, and possibly even for municipal treatment plants. Agents tested in this research included N-chlorosuccinimide, 2,4-dichloro-5,5-dimethylhydantoin, trichloroisocyanuric acid, calcium hypochlorite, commercial grade HTH, and household bleach. The total chlorine content of a water solution of agent I in a demand free environment remained constant over a period of at least 8 weeks. (Baker-FRC)
W84-00128

DEGRADATION OF ORGANOCHLORINE COMPOUNDS BY UV IRRADIATION WITH SIMULTANEOUS HYDROGEN PEROXIDE ADDITION UNDER WATERWORKS CONDITIONS (ABBAU VON ORGANOCHLORVERBINDUNGEN DURCH UV-BESTRAHLUNG BEI GLEICHZEITIGER WASSERSTOFF-PEROXIDE-ZUGABE UNTER WASSERWERKSBEDINGUNGEN),
Bremen Univ. (Germany, F.R.).
B. Stachel, B. Gabel, M. Cetinkaya, J. von Duszelen, and R. Kozicki.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 4, p 190-194, April, 1982. 4 Fig, 3 Tab, 43 Ref.

Descriptors: *Water treatment, *Oxidation, *Disinfection, *Ultraviolet, Hydrogen peroxide, Water analysis, Water quality, Organic compounds, *Organochlorine compounds, Agricultural chemicals, Hexachlorocyclohexane, Hexachlorobenzene, Heptachlor, Aldrin, Polychlorinated biphenyls, Dichlorobenzenes.

A study was made of the reduction of gamma-hexachlorocyclohexane (gamma-BHC), hexachlorobenzene (HCB), heptachlor, aldrin, polychlorinated biphenyl (2-PCB) and two dichlorobenzenes in water by UV-irradiation and simultaneous hydrogen peroxide addition. The study was designed to evaluate the UV/hydrogen peroxide method of disinfection and oxidation for water treatment. The reduction of these compounds under various hydrogen peroxide concentrations and water flux rates was measured. Reductions between 0 and 89% of the organochlorine compounds added were obtained. The reliability of the method was examined by error analysis, which gave an overall error for the method as a whole of 18.8%. Problems in the use of UV/hydrogen peroxide and capabilities of the method for purpose of water treatment include possible mutagenicity of hydrogen peroxide and its reaction products as well as the potential for formation of toxic intermediate degradation products. (Baker-FRC)
W84-00152

HYGIENIC EVALUATION OF ULTRAFILTRATION MEMBRANES PROPOSED FOR USE IN DRINKING WATER TREATMENT PRACTICES (GIGIENICHESKAYA OTSENKA UL'TRAFIL'TRATSIONNYKH MEMBRAN V PRAKTIKE OCHISTKI PIT'EVOI VODY),
Moskovskii Gosudarstvennyi Meditsinskii Inst. (I) (USSR).
N. Ya. Mikhailovsky, A. A. Korolev, Yu. A. Rakhmanin, T. G. Shlepnina, and G. V. Merkurieva.
Gigiena i Sanitariia, No 8, p 8-10, August, 1980. 2 Tab, 7 Ref.

Descriptors: *Membranes, *Ultrafiltration, *Polysulfonamide, Toxicity, Laboratory studies, Filtration, Membrane processes, *Water treatment, *USSR.

New polysulfonamide ultrafiltration membranes of the 'Vladipor' type were evaluated under conditions simulating their actual use in water treatment. The membranes performed satisfactorily and did not affect the physical or chemical properties of the water. Permanganate oxidizability and brominated substance contents were similar for membrane-filtered and control water samples. Little or no alteration of biochemical parameters was seen in rats supplied with membrane-filtered drinking water for 6 months. Thus, the membranes are recommended for use in water purification facilities for domestic and industrial water supply systems. (Author's abstract)
W84-00156

GEOPROCESSING - A WATER DISTRIBUTION MANAGEMENT TOOL,
For primary bibliographic entry see Field 7C.
W84-00196

WATER SUPPLY IN DEVELOPING COUNTRIES: IMPROVING ON CURRENT PRACTICE,
A. D. Barrett, and M. B. Pescod.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 5, p 323-342, September, 1982. 4 Fig, 4 Tab, 24 Ref.

Descriptors: *Water supply, *Developing countries, *Planning, Design criteria, Urban water supply, Rural water supply, Water supply development, Management.

A critical review is offered of current practices in water supply in developing countries. The needs of developing countries for urban and rural water supply will only be met if adequate funds are made available during the United Nations International Water Supply and Sanitation Decade and if improvements are made in current practice, both in planning and implementation, including training, operation and maintenance. Design criteria and

standards are reviewed in terms of the quality of drinking water, quantity of drinking water to be provided, population to be supplied, and the proportion of standpipes to house connections. Urban and rural water supply is considered, using source selection and development techniques, water treatment, and water distribution. The subject of technology transfer contains reviews of local level education, on the job training, research and development and the role of international agencies. Water supply master plans and feasibility studies include demand forecasts, staging and time factors, cost considerations and engineering studies along with specialist studies, and project appraisals. (Baker-FRC)
W84-00198

HUGE SEAWATER PLANT PERFORMS AS PLANNED,
For primary bibliographic entry see Field 3C.
W84-00291

ON THE HYGIENIC EVALUATION OF N-NITROSAMINES AND THEIR TRANSFORMATION PRODUCTS IN WATER (K GIGIENICHESKOY OTSENKE NEKOTORYKH N-NITROZAMINOV I PRODUKTOV IKH TRANSFORMATSII V VODNOY SREDE),
Moskovskii Gosudarstvennyi Meditsinskii Inst. (I) (USSR).
A. A. Korolev, N. Ya. Mikhailovsky, and A. P. Ilnitsky.
Gigiena i Sanitariia, No 8, p 11-14, August, 1980. 3 Tab, 9 Ref.

Descriptors: *Nitrogen compounds, Chemical reactions, Water treatment, Chlorine, Ozone, Ozonation, Activated carbon, Carcinogens, Nitrosamines.

This study found that N-nitrosamines (NA) are highly stable compounds. The most effective methods for eliminating them from water were found to be ozonation and the use of activated charcoal filters. The NA transformation products that were formed under the action of chlorine and ozone are not as toxic as, and accumulate less than, the N-nitrosamines. NA chlorination products have a blastomogenic action, the mechanism of which appears to differ from that of the NA itself. (Author's abstract)
W84-00292

WATER TREATMENT FOR INDUSTRIAL BOILER SYSTEMS,
C. R. Peters.
Industrial Water Engineering, Vol 17, No 6, p 16, 18-26, November/December, 1980. 9 Fig, 1 Tab, 7 Ref.

Descriptors: *Boiler water, *Corrosion control, *Chemical precipitation, Water treatment, Phosphates, Amines, Steam, Heat transfer, Chelation.

The objectives of boiler water treatment are satisfactory steam purity, minimum corrosion, and minimum deposition. A variety of treatments are available to fit the needs of the many types of boiler systems, ranging from simple, natural circulation to high pressure systems with complex flow patterns and multiple components. Antifoam treatments can reduce carryover and improve steam purity. Examples are given for calculating the carryover and amounts of contaminants present in the steam. Deposits, which retard heat transfer, may be controlled by chemical additions to prevent formation of precipitates or to form precipitates easily removed by blowdown. Corrosion control must be tailored to individual boiler systems. Possible treatments include conventional phosphate treatment (maintenance of phosphate and hydroxide residual), coordinate phosphate treatment (trisodium phosphate residual with no free sodium hydroxide), congruent phosphate treatment (prevention of sodium hydroxide formation under hideout conditions), all volatile treatment (ammonia or hydrazine), chelants (ethylenediamine tetraacetic acid and/or nitrilotriacetic acid), and condensate/feedwater system treatment (hydrazine, neutralizing amines, or filming amines). A table lists guidelines for water quality for boiler feedwater and boiler water for pressures up to 2000 psig. (Cassar-FRC)
W84-00297

CHLORINATION OF ORGANIC COMPOUNDS: CHLORINE DEMAND AND REACTIVITY IN RELATIONSHIP TO THE TRIHALOMETHANE FORMATION. INCIDENCE OF AMMONIACAL NITROGEN (CHLORATION DE COMPOSES ORGANIQUES: DEMANDE EN CHLORE ET REACTIVITE VIS-A-VIS DE LA FORMATION DES TRIHALOMETHANES. INCIDENCE DE L'AZOTE AMMONIACAL),
Poitiers Univ. (France).
J. deLaat, N. Merlet, and M. Dore.
Water Research, Vol 16, No 10, p 1437-1450, October, 1982. 10 Fig, 7 Tab, 17 Ref.

Descriptors: *Chlorination, *Organic compounds, *Chlorinated hydrocarbons, Water treatment, Chloroform, Trihalomethanes, Ammonia, Phenols, Aromatic compounds, Aliphatic compounds.

Formation of chlorinated organic compounds, especially trihalomethanes, during chlorination of surface water was studied by chlorinating a number of organic compounds at concentrations of 0.000001 to 0.00001 mole in neutral medium. The aliphatic compounds, including acids, aldehydes, and alcohols, were relatively inert to chlorination. On the other hand, chlorine demands of 5-12 moles of chlorine per mole of organic precursor were obtained with aromatic compounds of the phenol and aniline types. Many organic compounds produced chloroform at molar yields of $<5\%$. Metapolyhydroxybenzenes and metachlorophenols were especially good precursors of trihalomethanes. Kinetic constants of chloroform formation are given for acetone, acetylacetone, resorcinol, phloroglucinol, and 3,5-dichlorophenol. Although chlorine demands of some compounds were very high, the chloroform produced accounted for only a small proportion. Chlorination of resorcinol produced large proportions of trichloroacetic acid (molar yield $<10\%$) and monochloromaleic acid (molar yield 60%). Chlorination of 3,5-dichlorophenol produced tetrahalogenated and pentahalogenated three-carbon compounds. Chloroform was also produced in significant amounts during chlorination of highly reactive precursors in the presence of ammonia or amine compounds. (Cassar-FRC)
W84-00319

NEW APPROACH TO COOLING WATER TREATMENT PROVIDES INCREASED PLANT PROFITABILITY,
E. W. Ekis, Jr.
Industrial Water Engineering, Vol 19, No 4, p 10, 12-15, 1982. 5 Fig.

Descriptors: *Cooling water, *Corrosion control, Water treatment, Nalco Delta-T System, Delta-T System, Biocides, Training, Process control, Industrial water.

The Nalco DELTA-T approach is designed to enhance plant profitability by optimizing cooling water treatment systems. The concept includes problem solving, program selection, program management, problem anticipation, and special services. Safety and efficiency of adding liquid biocides were improved by the Bioductor feed system, based on the Venturi principle. Hydrocarbon leaks into the cooling water system, difficult to detect and responsible for up to thousands of dollars per day in damages, are located with the aid of a specially designed sample collection device. The samples are extracted with Freon and analyzed by a portable spectrophotometer. In choosing a suitable treatment system four basic corrosion control approaches are in use: chromate/zinc, alkaline zinc, all organic, and stabilized phosphate. Choice of a program depends on the individual situation, whether pH upsets, elevated temperatures, iron contamination, or inorganic phosphate contamination are present. Operator training programs are available to improve treatment systems management. The Delta-T program anticipates problems and has plans for dealing with them. For example, an accidental acid overload may be promptly handled by using an iron dispersant to limit fouling during the critical period. The program also has special services, such as an on-line method for removing iron-based deposits from cooling systems without shutting down plant production. (Cassar-FRC)
W84-00335

TREATMENT TECHNIQUES FOR REMOVING ORGANIC COMPOUNDS FROM GROUND WATER SUPPLIES,
Pirnie (Malcolm), Inc., Paramus, NJ.
J. E. Dyksen.
Industrial Water Engineering, Vol 19, No 4, p 16-21, 1982. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Organic compounds, *Activated carbon, *Aeration, Water treatment, Adsorption, Groundwater, Solvents, Chlorinated hydrocarbons.

Aeration and granular activated carbon adsorption are the most practical and effective treatment methods for removing volatile organic compounds from groundwaters. Some groundwater supplies contain significant concentrations of solvents, trichloroethylene and tetrachloroethylene being found most frequently. Aeration equipment is classified into two categories: diffused aerators, where bubbles are passed upwards through the water, and waterfall aerators, such as cascades, multiple trays, spray nozzles, and packed columns. Well-designed packed columns can remove volatile organics with efficiencies $>$ 99%. Efficiency depends on several factors, especially the Henry's Law constant. Granular activated carbon is the best available broad spectrum system for removing volatile organics, but effectiveness of adsorption is uneven. Of the solvents usually found in groundwater, higher molecular weight compounds and unsaturated compounds are adsorbed better than lower molecular weight compounds and saturated compounds. Adsorption isotherms are not sufficient to design a system. Pilot tests are necessary to account for the competitive adsorption among the solvents present. Off-site regeneration of spent carbon is usually more economical than on-site regeneration. (Cassar-FRC)
W84-00337

RECOGNITION OF PIPE LEAKS BY SHORT TERM MEASUREMENTS (ERKENNUNG VON ROHRLEITUNGSLECKS DURCH KURZZEITMESSUNGEN),
F. G. Heide.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 4, p 181-183, April, 1982. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Water distribution, *Leakage, *Drinking water, Water conveyance, Measurement techniques, Measuring instruments, Flow measurement.

Many water utilities conduct routine leakage surveys at regular intervals of a few years to identify sources of leaks and to reduce leakage in drinking water distribution systems. New methods, such as leakage analysis, and new instruments, such as the leak noise correlator, have been successfully applied in an effort to improve the efficiency of the search for leaks. However, using these methods, leaks are only detected at the time such surveys are conducted. A new, permanent leakage control method has been developed which uses measuring stations which perform regular, automatic, short duration measurements of the night flow at 24-hour intervals to allow determination of when and where the search for leaks should start. (Carroll-FRC)
W84-00341

5G. Water Quality Control

A TEST OF THE WATER AND LAND RESOURCE ANALYSIS SYSTEM IN THE NEW JERSEY PINE BARRENS,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
S. Pacenka, and K. S. Porter.

Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111848, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, October 1983. 56 p, 20 Fig, 3 Tab, 2 Append. OWRT A-100-NY(1), 14-34-0001-2134.

Descriptors: *Technology transfer, Hydrologic budget, *Groundwater pollution, *Nitrogen cycle, *New Jersey, *Mathematical models, Groundwater recharge, Hydrologic cycle, Pine Barrens.

Technical tools to help determine how best to protect ground-water recharge from contamination are not widely available. This report summarizes an effort to apply an evolving set of such tools, the Water and Land Resource Analysis System (WALRAS), in the New Jersey Pine Barrens. The WALRAS was originally developed by Cornell University to aid ground-water management on Long Island, New York. The Pine Barrens have similar soils and climate to Long Island, making the transfer hydrologically feasible. The areas also share concerns over nitrate contamination of ground water. The project cooperators, Cornell University, Rutgers University, and the New Jersey Pinelands Commission, focused their efforts on a pilot study area near Hammonton, New Jersey. During the course of the project, a number of technical manuals about the WALRAS were developed, its component computer programs were improved, and a data base was assembled for the pilot study area. The transfer experience pointed out the need for computer access early in such a model-based project. It also illuminated the need for personnel skilled in multidisciplinary data interpretation and mathematical model application. The New Jersey team's companion report describes the results of the pilot area test.
W84-00044

A LINEAR PROGRAMMING ECONOMIC ANALYSIS OF LAKE QUALITY IMPROVEMENTS USING PHOSPHORUS BUFFER CURVES,
Economic Research Service, Washington, DC.
C. W. Ogg, H. B. Pionke, and R. E. Heimlich.
Water Resources Research, Vol 19, No 1, p 21-31, February, 1983. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Phosphorus, *Lake restoration, *Nonpoint pollution sources, Model studies, Greenlane Reservoir, *Pennsylvania, Economic feasibility, Cultivation, Erosion control, Water quality control, Eutrophied lakes, Soil erosion, Agricultural watersheds, Watershed management.

The economic feasibility of reducing phosphorus loads from agricultural land to a water supply reservoir was investigated using a linear programming model, which combines economic and physical modeling. Phosphorus loss coefficients were estimated using the Universal Soil Loss Equation for runoff and soil erosion and phosphorus buffer curves for labile P. The curves relate soil and solution P concentrations, assuming chemical equilibrium. The buffer curve approach using labile P instead of the traditional total P has several advantages, including the fact that labile P is more closely related to algal growth, soil P fertility, and crop productivity than total P. The model was applied to Greenlane Reservoir, the most severely eutrophied water body in Pennsylvania. The target total P level was established at 65 micrograms per liter, far less than the present 262 micrograms per liter, of which 60% comes from point sources and 40% from nonpoint sources. The model produced a variety of crop and conservation practices for four combinations of point-nonpoint labile P control. Some suggested changes were wider use of contour and no-till, shifting more acreage to hay production, and growing alfalfa on the steeper slopes. (Cassar-FRC)
W84-00082

RAYONIER PRODUCES ANIMAL FEED FROM SECONDARY SLUDGE AT SULFITE MILL,
For primary bibliographic entry see Field 5E.
W84-00121

HOW THE ROCKY MOUNTAIN ARSENAL IS HANDLING GROUNDWATER CONTAMINATION,
Rubel and Hager, Inc., Tucson, AZ.
For primary bibliographic entry see Field 5D.
W84-00133

INVESTIGATIONS OF STRATEGIES FOR REDUCING AGRICULTURAL NONPOINT SOURCES IN THE CHOWAN RIVER BASIN,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
F. J. Humenik, B. A. Young, and F. A. Koehler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113562, Price codes: A09 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Completion Report, September 1983. 172 p, 8 Fig, 29 Tab, 21 Ref, 6 Append. OWRT A-110-NC(1), 14-34-0001-1135.

Descriptors: *Nonpoint pollution sources, Agricultural runoff, *Agricultural watersheds, Erosion control, Nitrogen, Phosphorous, Biological samples, Soil absorption capability, *Management practices, *Chowan River Basin, Stream discharge data, Water quality data, Watershed soils.

A three-year study was conducted in the Chowan River Basin to measure water quality changes resulting from implementation of best management practices (BMP's) to reduce agricultural nonpoint sources. Important components of the overall study framework were to conduct surveys for assessing agricultural practices and producer attitudes associated with the development and evaluation of an agricultural nonpoint source control program and to conduct a supportive publicity, educational and technical assistance program. A cooperatively executed field sampling program resulted in over 13,000 actual USGS flow values, and 876 concentration samples. Predictive models were developed to fill data gaps and allow calculation of annual yields. The total complement of data obtained in this study emphasized the need of employing the total systems approach in conducting and evaluating nonpoint source control programs on a watershed basis. Important components of this total systems approach are recommendations to control agricultural nonpoint sources and methods for evaluating water quality changes. Study results lead to a better definition and documentation of the advantages and limitations of monitoring to determine actual land loading coefficients and to evaluate specific relationships between BMP's installed, and resulting water quality changes on a watershed basis.
W84-00134

SANITARY HYDROBIOLOGY AND HYDROPARASITOLOGY. GENERAL PRINCIPLES OF POLLUTION PROTECTION OF LAKE WATERS,
Limnologicheskii Inst., Irkutsk (USSR).
G. I. Galeziy.
Hydrobiological Journal, Vol 18, No 2, p 48-51, 1982. 5 Ref.

Descriptors: *Water quality control, *Lakes, Water pollution sources, Water quality, Benthos, Plant life, Physical properties, Microorganisms, *USSR, Lake Baikal.

Lake Baikal, an extremely pure water lake, was monitored for the slightest changes in the water, and the entire ecologic system of the adjacent region was also studied to try to develop strategies and tactics for the protection of other lakes which unavoidably experience the effect of human activity. In the zone of discharge of the purified effluent of the Baikal pulp and paper mill some restructuring of the benthic biocenoses has already occurred. Four species of mollusks were found in the local zone where cellulose and lignin are deposited on the bottom. The groups of microorganisms have also changed. All of these changes have been induced by the effluent, the mineral salt content of which conforms to the level established for potable water. The results of many years of study suggest that it is practically impossible to protect such lakes and streams from pollution unless consideration is given to their specifics. Attention must be given to the species composition therein, physiology and functioning of the organisms which populate them, the stability and reproduction of hydrobiocenoses, the geographic position of the lake, its size, depth and volume of water in it, and other factors. Only when these are considered can measures be developed to preserve water quality, the natural properties of lakes and the surrounding plant and animal life. (Baker-FRC)
W84-00147

MANAGEMENT OF THE WATER-TABLE IN ALSACE. PROPOSAL FOR A PATRIMONIAL MANAGEMENT (LA GESTION DE LA NAPPE PHREATIQUE D'ALSACE. PROPOSITION POUR UNE GESTION PATRIMONIALE),
P. Gendrin.
Techniques et Sciences Municipales, No 2, p 89-92, February, 1981. 6 Ref.

Descriptors: *Water resources development, *Water quality management, Water management, Management planning, Groundwater management, Administrative agenies, France, Alsace.

Due to the favorable conjunction of the limits of the Alsatian region and of the presence of a very important groundwater reservoir, it is proposed that a regional patrimonial institution be created to manage the Alsatian water resource at its sources--both surface and underground--prior to any appropriation for exploitation of this water. The aim of such a regional institution would be to preserve the quality of the groundwater, which is currently inadequately protected against pollution from the soil surface which results from the remarkable economic development and urbanization which has occurred in Alsace during the last decades. The proposed solution involves resorting to a water resources management program proceeding on multiple levels and through multiple partners. It is recommended that the management be of the patrimonial type and take into account, before any decision regarding water resources, all present and future concerned interests. (Carroll-FRC)
W84-00306

CONTROLLING COOLING TOWER PH AND CYCLES OF CONCENTRATION,
For primary bibliographic entry see Field 5D.
W84-00343

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

CALIBRATION OF LARGE-SCALE ECONOMIC MODELS OF THE AGRICULTURAL SECTOR AND RELIABLE ESTIMATION OF REGIONAL DERIVED DEMAND FOR WATER,
California Univ., Davis. Dept. of Agricultural Economics.
R. E. Howitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110857, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, August 1983. 32 p, 9 Fig, 3 Tab. OWRT A-087-CAL(1).

Descriptors: *Model studies, *Regional planning, *Calibrations, *Linear programming, Costs, Water resources planning, Water resource management, *Water demand, Irrigation, *California.

Given the importance of regional response in physical and economic terms to water resource planners, large scale regional models are a widely used component of water resource management. Given the absence of a sufficiently rich data base to estimate cost functions by econometric approaches, linear constrained optimization models have been extensively used to derive normative estimates of former response to water policy. A long standing problem in linear models is the inevitable trade-off between the precision of calibration

f the model and the constrained nature of the olution. Often model results significantly depart om empirical reality with deleterious effects on olicy. This research shows that a nonlinear cost nction formulation overcomes the constraint roblem when the function parameters are estimat- d from actual farmer responses. The Positive Qua- ratic Programming (PQP) theory developed was pplied to the California Agricultural and Re- ources Model (CARM) and used to estimate emand functions for irrigation water by region. Snyder-California)
V84-00012

UIDELINES FOR INTERACTIVE COMPUT- R SOFTWARE IN WATER RESOURCES EN- INEERING,
dvanced Engineering Software, Irvine, CA.
. V. Hromadka, J. M. Clements, and G. L. uymon.
Vater Resources Bulletin, Vol 19, No 1, p 91-96, ebruary, 1983. 3 Fig, 5 Ref.

Descriptors: *Water resources development, Computers, Hydrology, Microcomputers, Programming, Training, Software, Decision making, Water management, Planning.

A case study is presented in the preparation of umanized computer software for water resources ngineering studies. Considerations are included of vhat should be in a computer software library evelopment plan. A brief presentation of human- zed software guidelines is included along with the se of the programming techniques for computer ided design. The techniques presented provide an pplication of state-of-the-art programming tech- iques to water resources engineering program- ing needs. By establishing a uniform user-friendly et of program guidelines at an agency or firm, the rogram training expenditure associated with new rogram users is minimized. Additionally, errors in rogram usage is virtually eliminated due to the ase of program use. The techniques provided are mployable on most computers of the mainframe nd minicomputer classes, as well as many current- y available microcomputers. Generally, no formal raining is needed for program use, and no pro- ram user's manuals are needed. Since water re- ources related studies and design problems gener- lly involve significant computational effort with nultiparameter models, the capability to conduct everal studies exploring various design alterna- ives or model parameter sensitivity is needed. However, by using humanized software the costs f such iterative studies is significantly reduced. For example, a Southern California runoff hydro- graph procedure generally costs about 40 man ours of a hydrologist's time. Using humanized rogramming, a hydrograph can be developed in ess than 10 minutes' time. Consequently, water esources firms should explore and incorporate a tandard humanized software plan into their com- any software development program. (Baker-FRC)
W84-00113

WATER CONSTRAINTS ON ENERGY DEVEL- OPMENT: A FRAMEWORD FOR ANALYSIS,
California Univ., Berkeley. Div. of Energy and Environment.
J. Harte.
Water Resources Bulletin, Vol 19, No 1, p 51-57, February, 1983. 1 Fig, 14 Ref.

Descriptors: *Water resources development, *Energy conservation, Water supply, Drought, Energy sources, Fuel, Water demand, Management, Decision making, Stochastic processes.

A study of the impacts of future energy development on freshwater resources was carried out as part of the US National Academy of Sciences' CONAES study. The results led to the identification of severe constraints on US energy development that could arise in the future due to geographic and temporal variability of the freshwater resource. In order to obtain a rational resolution of the political problems that will be generated in the future it is necessary that planning based on predictions of future energy supply and demand be replaced by scenario or 'what if' analyses; that full attention be paid to the uncertainties in per-unit-energy water requirements; that suitable stochastic measures of water availability be used to compare water supply with water demand; that realistic ecological criteria, and other alternative use criteria, be developed for estimating impacts of water withdrawn or consumed for energy development; and that human consequences of ecological impacts be described in a manner that will allow the political process to intervene in an optimum manner to allocate water resources. (Baker-FRC)
W84-00115

URBAN STORMWATER MANAGEMENT NEEDS IN NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
H. R. Malcom, and J. M. Sappington.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-113687, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 199, August 1983. 111 p, 10 Fig, 11 Tab, 36 Ref, 2 Append. OWRT B-116-NC(1), 14-34-0001-9125.

Descriptors: *Storm runoff, *Institutional constraints, Stream degradation, Stream erosion, *Urban watersheds, *North Carolina, *Stormwater management, Water quality.

Current practices in stormwater management were examined to provide recommendations for improvement, particularly in the areas of institutional arrangements and technical support. Because of fragmented institutional arrangements and site-specific conventions of design, the network of urban streams suffers from lack of comprehensive treatment of problems of flooding, sedimentation and inferior water quality. If public perception of the value of a better-performing urban stream system is sufficiently well formed to support systematic improvement, the approach recommended is to reform the current fragmented system into a stormwater public utility in parallel to those of water, sewer and street systems. Set at the local level, the public-utility approach would provide for the needed comprehensive planning, design and management. The principal analytical resource needed is that of watershed modeling to simulate urbanizing watersheds adequately for making the planning and design decisions respecting the interactions of system components. A micro-computer program was prepared which uses impulse analysis for the study of streambank behavior under the influence of varying hydrograph shapes. The program, user instructions and case studies are given. An annotated bibliography of reference materials on project topics is included.
W84-00166

CONSTRUCTION OF AN INTEGRATED AND ECONOMICALLY EFFICIENT WATER ALLOCAION PROCESS FOR THE FLINT RIVER,
Georgia Univ., Athens. Inst. of Natural Resources.
H. F. Wright, and R. M. North.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-117241, Price codes: A04 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 15-83, Georgia Inst. of Technology, Atlanta, September 1983. 50 p, 2 Fig, 1 Tab, 35 Ref. OWRT A-104-GA(1), 14-34-0001-2111.

Descriptors: Allocation, Flint River Basin, *Georgia, Water budget, State water plan, *Water allocation, *Water law, *Water permits, Water prices, Water resources management.

The economic theory of common property resources, as they exist in the Flint River Basin, are described as a prerequisite to establishing a river basin management strategy. Three alternative approaches are presented as they might be applied to a management strategy that integrates water quality with water supply decisions for both surface waters and ground waters. The principal focus is on identifying the relationship between existing legal institutions and economically optimum allocation mechanisms. Specific management concerns are identified for the Flint River Basin and each concern is addressed in terms of the implications of a proposed marketable water rights system that would include water quality (pollution rights) and water supply (withdrawal rights). This type of system would be implemented only as overall scarcities of the water resources increased its value substantially above any transaction costs of establishing the system. The trading aspect will be many years off but the principle of allocations is sequentially higher valued uses through the effluent withdrawal permitting processes on a gradual (attrition type) basis.
W84-00199

WATER RESOURCES PLANNING IN THE SUSA-BASIN BY MEANS OF A SIMULATION MODEL,
Technical Univ. of Denmark, Lyngby.
J. Knudsen, and D. Rosbjerg.
Nordic Hydrology, Vol 13, No 5, p 323-338, 1982. 18 Fig, 1 Tab, 4 Ref.

Descriptors: *Water resources planning, *Model studies, Susa Basin, Denmark, Catchment areas, Water supply, Waste water disposal, Recreation, Irrigation, Water use, Water demand, Planning.

As part of the Susa project a combined hydrological/water quality simulation model was developed for water resource planning purposes. The model provides a detailed analysis of the consequences of meeting the demands of conflicting interests, including water supply, wastewater disposal, irrigation, and recreation. The recognition of the mutual dependency of each of these interests is crucial to ensure overall coordination of water resources utilization. This recognition is indispensable for providing a sound basis for political decisions on future water resource developments. It is shown that it is possible to establish a unified system of models, enabling multiple effects of water resource dispositions to be analyzed. By employing such models to assess hydrological, water quality and economic impacts of different alternatives, the information base for the final decisions can be substantially improved. (Baker-FRC)
W84-00326

6B. Evaluation Process

WATER RESOURCES IN ISRAEL AND THE NEED FOR DESALINATION,
Ministry of Agriculture, Tel-Aviv (Israel). Water Commission.
For primary bibliographic entry see Field 3A.
W84-00261

PAST DEVELOPMENTS AND PROBABLE EVOLUTION OF THE STRUCTURE AND ORGANISATION OF SERVICE STAFF IN THE WATER SECTOR AS A RESULT OF THE INTRODUCTION OF AUTOMATION (EVOLUTION PASSEE ET PREVISIBLE DE LA STRUCTURE ET DE L'ORGANISATION DU PERSONNEL DU SERVICE DES EAUX, RESULTANT DE LA MISE EN PLACE D'AUTOMATISMES),
Compagnie Generale des Eaux, Paris (France).
M. Rapinat.
Aqua, No 1, p 241-244, 1981. 7 Fig.

Descriptors: *Automation, *Personnel management, *Manpower, Computers, Water treatment facilities.

Automation in water services in the past has profoundly shaken the structure and organization of personnel in this industry. It is likely that the new forms of automation currently being considered for application in water management will bring changes affecting new groups of personnel in this field. In the past, automation was implemented to economize on the use of technical personnel and to increase the effectiveness of certain water purification stages. These changes resulted in an improvement in working conditions, a reduction in posted personnel, and a significant need for re-training in the use of new techniques, which resulted in an improvement of employee qualifications. These changes had no significant effect on administrative

activity. However, the efficiency and flexibility of new automation devices based on programming will have a considerable effect on requirements for administrative personnel and only a minor effect on the need for personnel in the technical domain. The objectives of these types of automation will be to improve the economic factors bound to operation, to reduce the number of posted personnel, and to further improve working conditions. Current progress in automation in water services can be expected to result in cost reduction, water quality improvement, improved working conditions, and upgrading of personnel. (Carroll-FRC)
W84-00309

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ANALYSIS OF TAX INCENTIVES FOR INTENSIVE IRRIGATION DEVELOPMENT IN THE NEBRASKA SANDHILLS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
M. E. Baker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110782, Price codes: A02 in paper copy, A01 in microfiche. Nebraska Water Resources Center Completion Report, September 1983. 12 p, 3 Ref, 1 Append. OWRT A-070-NEB(1), 14-34-0001-2129.

Descriptors: *Land development, *Investment, *Tax rate, Regulations, Management analysis, Farm managment, Irrigated land, *Economic justification, Economic prediction, Benefit-cost analysis, *Nebraska, Tax incentives, Irrigation development, Cash flows, Return on equity.

The overall objective was to quantify tax incentives for concentrated irrigation development in the Nebraska Sandhills. Budgets for investments, costs and returns for crop production and analysis of resulting income tax liabilities were simulated for case studies of irrigation developers who were: (1) ranchers, (2) farmers, (3) long-term investors, and (4) short-term investors. The unit of analysis was one center pivot system on a quarter section of former Sandhills rangeland. The returns on equity ran over 60% per year in some years for some investors. Likewise, returns of 4 to 6% per year were also common. The wide range reflected the effects of income tax regulations which permit deduction of interest and depreciation. The short-term investors maintain high returns on equity by liquidating after every fifth year. Reinvesting to tax shelter this income permits the development of 3 new quarters from the proceeds of the first one. For most investors, before-tax cash flows were negative until the loan on the well and center pivot was retired. Thus, for most investors, nonfarm income or income from other farm enterprises was required to supplement revenue from irrigated crop production during the repayment of well and pivot loans. After-tax cash flows were positive for all simulated cases. The flows increased with increases in leverage and marginal tax rates.
W84-00005

COMMENTS ON THE NATIONAL WATER COUNCIL'S CONSULTATION PAPER 'CHARGING HOUSEHOLDS FOR WATER'.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 2, p 105-108, March, 1981.

Descriptors: *Water metering, Economic justificaton, *Water rates, Economic aspects, *Economic feasibility, Cost sharing, Expenditures, Marketing, Payment, Prices, *Domestic water.

The Institution of Water Engineers and Scientists have replied to the National Water Council's paper dealing with various methods by which households could be charged for water service. Three major issues have necessitated changes in charging policies as they now stand. These influences were: the Water Act of 1973, which imposed a legal requirement on water undetakings to introduce charging systems by April of 1981 that show no undue preference or discrimination between classes of ratepayers; the introduction of direct billing by water authorities, highlighting the cost of combined water services; and the highly capital-intensive character of the water industry's operations, leading to more than half of the revenue from charges being absorbed by the servicing of capital expenditure, thus causing faster increases in consumers' charges than the general rate of inflation. The Institute notes that there is a clear attempt to improve the efficiency, reliability and general technology of metering. However, it is suggested that optional metering is to some degree a financial palliative. The Institute feels that the actual adoption of metering will not be significant except than in the commerical sector. The thoughts of a member of the Institute are also published; he urges that further consideration be given to how other countries manage their charging systems before moving toward optional metering. (Baker-FRC)
W84-00015

IMPACT ON RESIDENTIAL WATER CONSUMPTION OF AN INCREASING RATE STRUCTURE,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
C. E. Young, K. R. Kinsley, and W. E. Sharpe.
Water Resources Bulletin, Vol 19, No 1, p 81-86, February, 1983. 3 Fig, 4 Tab, 20 Ref.

Descriptors: *Water conservation, *Water rates, Water supply, Water resources development, Economic aspects, Public policy, Metering, Pricing.

A two-step procedure is described for use in estimating the impact of an increasing rate structure on residential water use. An error components regression procedure is used to estimate demand relationships for a period prior to the rate change. Water use is predicted for the post rate change period, assuming that the rate structure was not changed. Comparison of actual with predicted use indicates that water use declined as a result of the imposition of the increasing rate structure. Average residential water use in the WSSC's service area has been decreasing since 1974. A portion of this decreasing trend can be attributed to the overall success of the WSSC's water conservation programs. Additional reductions in water use resulted from the imposition of an increasing rate structure for water on January 1, 1978. Comparison of actual use with estimated use, assuming that the increasing rate structure was not instituted, revealed that actual use decreased in 1978 and 1979. Estimated reductions in water use ranged from 1.1 to 8.7%. A portion of this decreased use can be attributed to changes in water use habits. It remains to be seen whether or not these habit changes are maintained after the WSSC's customers become accustomed to the new rate structure. (Baker-FRC)
W84-00100

CHANGES IN WATER POLICY IN THE PEOPLE'S REPUBLIC OF CHINA,
Purdue Univ., Lafayette, IN. Dept. of Political Science.
L. Ross.
Water Resources Bulletin, Vol 19, No 1, p 69-72, February, 1983. 2 Tab, 9 Ref.

Descriptors: *Water policy, *Metering, *Water demand, Water use, Conservation, Water conservation, *China, Policy, Public policy, Regulations, Economic aspects.

A major change has taken place in the last few years in the regulation of water usage in China. This change was encouraged by the occurrence of severe drought in the north China plain, including the politically important cities of Beijing and Tianjin. The drought enhanced the prominence of economics as part of the current modernization drive (control of water use through price regulation). China's cabinet recently committed the country to the introduction of metering and usage sensitive pricing along with other conservation measures. However, the speed at which metering can actually be carried out and the quality of managment which will be given the endeavor are uncertain at this time. The high hopes currently placed on these measures may be exaggerated. Since individual meters will be costly to install and difficult to monitor, group meters are likely to be widespread creating problems of group incentives and mutual supervision. Further, utility companies which are owned by the state may require additional rate making assistance if their sales decline too precipitously. China's present consumption also is very low. As the economy develops additional water supplies will be required, although market solutions should reduce and slow down the need for new supplies. Political opposition may yet arise in response to the wide use of markets to force conservation, as this would be ideologically opposed to much of the political climate in the country. (Baker-FRC)
W84-00102

PRICING AS A POLICY TO REDUCE SEWAGE COSTS,
Maryland Univ., College Park. Dept. of Agricultural and Resource Economics.
M. Strudler, and I. E. Strand, Jr.
Water Resources Research, Vol 19, No 1, p 53-56, February, 1983. 1 Tab, 16 Ref.

Descriptors: *Costs, *Wastewater treatment, *Pricing, *Maryland, Elasticity of demand, Water rates, Economic aspects, Water pollution control.

Compliance with the Federal Clean Water Act is expected to cost $3 billion for the state of Maryland, of which $1 billion must be paid by the citizens and $2 billion is available from federal grants. Reducing sewage flows by charging a modest water/sewage fee for residential water use ($2 per thousand gallons) would reduce costs of compliance by a total of $21 million. Of 61 facilities, 29 charge nothing for use or disposal of water and 16 have a per capita daily use greater than 100 gal. Twenty-one towns with no water charge or a water charge less than $2 per thousand gal and a daily per capital use of more than 100 gal were used in a cost analysis. Raising the water charge to $2 per thousand gal in these towns would reduce daily sewage flow by 1.9 million gal and reduce annual costs by $14.4 million. Largest cost savings would be in Patpsco ($5.3 million), Savage, ($1.6 million), Bowling Green ($1.5 million), Frederick ($1 million), and Chestertown ($910,000). The elasticity of disposal demand was estimated to be -0.07. Thus a 14% increase in prices would decrease sewage flow by about 1%. (Cassar-FRC)
W84-00131

6D. Water Demand

ADAPTING WATER SERVICES TO URBAN GROWTH: A CASE STUDY OF SALT LAKE COUNTY,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6E.
W84-00031

WATER REQUIREMENT FOR COAL SLURRY TRANSPORTATION,
Kentucky Water Resources Research Inst., Lexington.
D. T. Kao, and S. L. Rusher.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111749, Price codes: A06 in paper copy A01 in microfiche. Research Report No 146, September 1983. 104 p, 17 Fig, 14 Tab, 36 Ref, 2 Append. OWRT A-089-KY(1), 14-34-0001-2119.

Descriptors: *Water demand, *Water allocation, Slurries, Pipe flow, Pipelines, Coal, *Water requirements, *Coal slurry pipelines, Coal slurry transportation, Coal slurry pipeline design.

The amount of water required for coal slurry transportation is a function of coal properties and the magnitude of coal movement. The pipeline system characteristics and the method of slurry preparation also effects the overall water requirement of the system. In the present study methodologies are developed based on reported and modified coal slurry flow correlation equations to determine the quantity of water needed under various

coal transport and flow conditions. Auxiliary water requirements including start-up and flushing water storage; related evaporation and seepage losses are also included. A computer program and several monographs are presented to provide a quantitative estimation of water requirements for fine to coarse coal slurry transport. The results are useful to the slurry pipeline design engineers in providing essential information for state and local water allocation policy determination.
W84-00034

CHANGES IN WATER POLICY IN THE PEOPLE'S REPUBLIC OF CHINA,
Purdue Univ., Lafayette, IN. Dept. of Political Science.
For primary bibliographic entry see Field 6C.
W84-00102

WATER CONSTRAINTS ON ENERGY DEVELOPMENT: A FRAMEWORD FOR ANALYSIS,
California Univ., Berkeley. Div. of Energy and Environment.
For primary bibliographic entry see Field 6A.
W84-00115

WATER SUPPLY IN DEVELOPING COUNTRIES: IMPROVING ON CURRENT PRACTICE,
For primary bibliographic entry see Field 5F.
W84-00198

DEVELOPMENT OF A PROTOTYPE SOFTWARE PACKAGE FOR PROJECTING WATER DEMAND AT THE SUBCOUNTY LEVEL,
Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
E. C. Ratledge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-117258, Price codes: A03 in paper copy, A01 in microfiche. Delaware Water Resources Center Completion Report, October 1983, 36 p, 24 Tab. OWRT A-057-DEL(1), 14-34-0001-2108.

Descriptors: *Data processing, Population dynamics, Planning, Growth rates, *Water demand, Water management, Administrative decisions, Water use, Projections, Water distribution, Mathematical studies, Prediction, Public policy, *Delaware, *Local governments.

A prototype software package which would produce alternative estimates of water demand at the subcounty level was developed. The design dictated the use of data which was routinely available in a large number of jurisdictions. Further, the software had to be flexible in order to allow testing of alternative assumptions and to accept new data as actual population, employment, or water demand data became available. The tool is designed for use by managers of water resources; however the design is flexible enough to permit estimation of many population-based service demands.
W84-00200

WATER RESOURCES PLANNING IN THE SUSA-BASIN BY MEANS OF A SIMULATION MODEL,
Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 6A.
W84-00326

6E. Water Law and Institutions

LEGAL ASPECTS OF WATER RESOURCES: A SURVEY OF THE LAW IN GEORGIA,
Georgia Univ., Athens. Inst. of Natural Resources.
J. O. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-110816, Price codes: A12 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 05-83, Georgia Institute of Technology, Atlanta, April 1983. 255 p, Ref.(footnoted). OWRT A-101-GA(1), 14-34-0001-2111.

Descriptors: Drinking water, Erosion, *Georgia, Groundwater, Hazardous waste, *Legislation, Marshland protection, Permit systems, Pollution control, *Regulation, Sedimentation, Shore protection, Surface water law, Water administration, *Water allocation, *Water law, *Water permits, *Water quality, Water quality protection, Wetland protection.

In the decade of the 70's, the Georgia and Federal legislatures virtually rewrote the body of substantive law affecting water resources. The approach of the Georgia legislature, that portion of the law of the period which is addressed in this report, was to initiate change in areas it perceived needed to be changed and to respond positively to Federal initiatives that otherwise would have preempted State authority in broad areas of natural resources/water law traditionally administered by the State. The result has been an important accumulation of statute law and regulation which treats comprehensively the important issues of water resource protection and allocation.
W84-00008

ADAPTING WATER SERVICES TO URBAN GROWTH: A CASE STUDY OF SALT LAKE COUNTY,
Utah Water Research Lab., Logan.
D. T. Larson, K. R. Kimball, C. W. Hiibner, and J. M. Bagley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111715, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-83/05, August 1983. 105 p, 14 Fig, 21 Tab, 122 Ref. OWRT B-208-UTAH(1), 14-34-0001-1272.

Descriptors: *Institutional constraints, *Legal aspects, *Local governments, Water districts, *Political constraints, Political aspects, Utilities, Utility extension, *Urban planning, Community development, Water supply, Municipal water, Municipal wastewater, *Utah, Salt Lake County.

Urbanizing areas throughout the nation are considering governmental reorganization or consolidation to coordinate planning and improve the cost effectiveness of the delivery of public services. More efficient water supply and wastewater services may become important in the political debate over reorganization. However water factors figure politically, accomplished reorganizations must carefully plan for efficient provision of water services. This study profiles the structure and interactions of municipalities and water service agencies in Utah's Salt Lake County during the 1970s. Both 1975 and 1978 attempts to consolidate Salt Lake City and the unincorporated area of the County failed. The voting patterns, interest group positions, and issues are examined. One major water issue surfaced in a concern that service jurisdictions and financial obligations were not sufficiently defined to protect the communities previously bound through water service agreements but excluded from the consolidated government. Additionally, the proposed dissolution of the County water conservancy district raised doubts on the division of equity in water rights and distribution facilities. Any large water development stabilizes institutional arrangements to a degree which may become a financial and legal constraint to desired change. Overall, nonwater issues dominated the decision in this water sensitive area. This implies that water service jurisdictional alignments are set by political decisions based on nonwater considerations. Water utilities must do their best to be effective in the resulting context.
W84-00031

1973-1983 SUPPLEMENT TO SURVEY OF OREGON'S WATER LAWS,
Oregon Univ., Eugene. School of Law.
C. D. Clark.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-111764, Price codes: A12 in paper copy, A01 in microfiche. Water Resources Institute Publications WRRI-81, Oregon State Univ., Corvallis, September 1983. 254 p, 108 footnotes plus statute and case citations. OWRT A-057-ORE(1), 14-34-0001-2139.

Descriptors: *Water law, *Water rights, *Appropriation, Boundary disputes, Liability, Negligence, Ownership of beds, Permits, Property boundaries, *Riparian rights, *Oregon.

Oregon water law was initially based upon the riparian and appropriative doctrines as proprietary systems for the allocation of water resources. State interest was first asserted systematically in the 1909 Surface Water Code. It abolished inchoate riparian rights, provided for the adjudication of pre-1909 vested rights, established a permit system for surface water use, and provided for state administration of water rights. Various enabling statutes have since provided for eight water management districts. Over time, the legislature withdrew streams from appropriation for scenic and municipal water supply purposes. A 1927 Groundwater code was applied to eastern Oregon. It was replaced in 1955 by a comprehensive Groundwater Act. Also in 1955, a water planning statute created a Water Resources Board with authority to classify waters for future use and to establish minimum stream flows for fish life. Since 1955 planning has been accomplished though 12 basin program statements; 19 watermaster districts provide field assistance and enforcement water laws. In 1975 the Oregon legislature merged the State Engineer's office and the Water Resources Department. Since 1975, a basic problem has been the scarcity of funds to complete adjudications, to establish critical groundwater areas, to staff the 19 watermaster districts, and to update the 12 basin program statements. The effort to determine navigability and state ownership of the beds of navigable streams was aborted by the 1983 legislature. The 1983 legislature also emphasized the creation of minimum stream flows. Oregon has considerable case law on problems relating to water boundaries, water drainage, and liability for escaping water.
W84-00036

THE CONTINUING EVOLUTION OF AN AUSTRALIAN WATER RESOURCES POLICY,
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
P. Crabb.
Water Resources Bulletin, Vol 19, No 1, p 23-28, February, 1983. 1 Fig, 1 Tab, 42 Ref.

Descriptors: *Water resources development, *Legislation, *Australia, Regulations, Policy, Water management, River Murray, Rivers, Water demand, Water supply.

The limited water resources of Australia highlight the need for policy guidelines for water management. A gradual evolution of a national water resources policy took place during the 1970s, facilitated by a nationally agreed statement of objectives and culminating in a federal policy statement presented in 1979. However, the Australian constitution delegates the major responsibility for water resources to the states. The federal policy statement seems to assume that each state has a water resources policy and that it accords with the nationally agreed objectives. This is not the case, and the practical management of Australia's water resources falls short of the principles set out in the document of policy. The River Murray, which is the nation's major water resource, provides ample evidence of this fact. In view of its very limited water resources it is urgent that Australia reduce the disparity between principle and practice in their management. (Baker-FRC)
W84-00088

WATER RESOURCES ORGANIZATIONS IN GEORGIA,
Georgia Univ., Athens. Inst. of Natural Resources.
K. J. Hatcher, and R. C. Chambers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-117274, Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 14-83, Georgia Inst. of Technology, Atlanta, September 1983. 87 p, 6 Fig, 7 Tab, 9 Ref. OWRT A-094-GA(1), 14-34-0001-1111.

Descriptors: *Georgia, *State agencies, Local governments, Comprehensive management, *Govern-

ment agencies, *Institutional arrangements, Multiple objectives, Water resources management.

The natural resources of water quality, water quantity, surface water, and ground water are currently managed through water programs in various federal, state and local agencies. More efficient water management and resources utilization would result if agency programs were better coordinated to manage the water resources and water users as a system. This report seeks to facilitate more coordinated water resources management by providing a compilation and summary of water management activities by local, state, federal, and private organizations in Georgia.
W84-00202

6F. Nonstructural Alternatives

ANALYSIS OF TAX INCENTIVES FOR INTENSIVE IRRIGATION DEVELOPMENT IN THE NEBRASKA SANDHILLS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W84-00005

7

SETTING EFFLUENT AMMONIA LIMITS TO MEET IN-STREAM TOXICITY CRITERIA,
Washington State Dept. of Ecology, Olympia.
W. E. Yake, and R. K. James.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 303-309, March, 1983. 7 Fig, 11 Ref.

Descriptors: *Ammonia, *Regulations, Effluents, Legislation, Decision making, Monitoring, Water pollution control, Water quality control, Quality control, Seasonal variations, *Toxicity, Effluent standards, Effluents, *Water quality standards, *Washington.

Statewide policy guidelines for setting effluent ammonia limits are presently being sought by the Washington State Department of Ecology. A method for setting effluent ammonia limits that protect against in-stream, un-ionized ammonia toxicity is described. The method described uses fixed-station, long-term receiving water data and river flow records to establish seasonal effluent limitations. Seasonal limits provide the ability to meet the in-stream criterion with a high degree of reliability while simultaneously minimizing the need for additional construction of treatment works and higher operating costs at treatment facilities. This desirable result is particularly marked in the case of un-ionized ammonia, because it turns out that this highest risk season, summer at low flow, is also the season during which in-plant nitrification is most easily achieved and maintained. The method accounts for seasonal functions in pH, temperature, flow, and background ammonia concentrations. It can be applied consistently across the state. It uses currently available data, and thus delays in data collection and lack of the resources needed to plan, execute, and publish intensive receiving water survey results are not a problem. The method is also flexible enough to accommodate policy decisions needed to implement the method. (Baker-FRC)
W84-00017

THE IMPACT OF FLOODPLAIN REGULATIONS ON RESIDENTIAL LAND VALUES IN OREGON,
Oregon State Univ., Corvallis. Dept. of Geography.
K. W. Muckleston.
Water Resources Bulletin, Vol 19, No 1, p 1-7, February, 1983. 4 Fig, 2 Tab, 2 Ref.

Descriptors: *Flood plains, *Regulations, *Land appraisals, *Oregon, Flood control, Legislation, Non-structural alternatives.

Ambiguities about the relationship between floodplain regulations and residential land values were investigated. Clarification of this relationship should facilitate the long-delayed implementation of a more comprehensive and successful approach to flood hazard mitigation than is presently employed. The suggestion that current floodplain regulations significantly depress appreciation rates of regulated lands relative to those of similar unregulated lands was rejected in most cases. When this suggestion was accepted the circumstances rendered the conclusions tenuous. Problems and issues facing this type of research are presented in case studies of two of the research study areas. However, it is pointed out that conclusions at this juncture should remain tentative because the research could not be carried out under ideal conditions. First, all of the criteria for establishing uniform study areas could not be met, even though much attention was paid to this step in the research process. One particular problem is that considerable development had taken place in some of the study areas prior to the implementation of floodplain regulations. Under these conditions a valid question regarding the relation between regulation and land values appears to be whether any possible negative aspects of land use regulations are not outweighed by the positive attributes of flood insurance, which under the NFIP becomes available concurrent with the implementation of regulations. (Baker-FRC)
W84-00089

ENHANCING THE EFFECTIVENESS OF PUBLIC PARTICIPATION IN DEFINING WATER RESOURCE POLICY,
Wisconsin Univ.-Madison. Water Resources Center.
L. -J. Schierow, and G. Chesters.
Water Resources Bulletin, Vol 19, No 1, p 107-114, February, 1983. 1 Fig, 1 Tab, 35 Ref.

Descriptors: *Public policy, Water resources development, *Education, Training, Management, Water management, Decision making, *Water policy.

The scope of the instructional deficiency in the participations of the public in defining policy for water resource development was studied. While millions of dollars are spent annually on public involvement programs, many of the goals for these programs are not achieved. One reason may be the lack of emphasis on educational programming. Professional expertise which is available to guide the development and implementation of instructional programs is not being used, and existing informational programs are inadequate to meet educational objectives. Eleven interdependent educational goals are identified such that achievement of each goal improves the likelihood of achieving others. Evaluations indicate that the incorporation of mechanisms employed by professional educations is a potential remedy to the lack of knowledge apparent at the public level. An individualized educational program is recommended to meet the needs of a heterogeneous adult audience. (Baker-FRC)
W84-00112

6G. Ecologic Impact Of Water Development

A COMMENT ON THE PAPER BY JOHN R. M. KELSO AND GARY S. MILBURN: 'ENTRAINMENT AND IMPINGMENT OF FISH BY POWER PLANTS IN THE GREAT LAKES WHICH USE THE ONCE-THROUGH COOLING PROCESS, (J. GREAT LAKES RES. 5:182-194, 1979),
Toledo Edison Co., OH.
J. Scott-Wasilk, R. Kunshek, D. T. Michaud, A. E. Gaulke, and J. H. Balletto.
Journal of Great Lakes Research, Vol 7, No 4, p 491-497, 1981. 3 Tab, 23 Ref.

Descriptors: Fish populations, *Entrainment, *Impingement, Powerplants, Hydroelectric plants, Cooling, Great Lakes, *Fish handling facilities.

An evaluation is presented of an earlier assessment of entrainment and impingment impact of the 89 steam-electric generating stations on Great Lakes fish stocks. The original evaluation inappropriately compared 1975-76 impingement losses to outdated commercial catch statistics for years prior to 1970. More recent statistics for one region of the Great Lakes which has supported a commercial fishery for almost 100 years document the supposition that the commercial catch is increasingly dominated by ecologically less desirable, but very abundant species. The earlier evaluation stated that 85% of the total numbers of fish impinged and entrained are of these very abundant species. Despite the large numbers of impinged and entrained fish, the numbers of alewife caught commercially in Lake Michigan have been steadily increasing over the past several decades. The earlier report estimated that large numbers of fish larvae were entrained and killed at power plants. However, as with impingement, the impact of the large number of larvae entraind is small when compared with the probable total number of larvae in the lakes. Entrainment losses in the earlier study are also represented as improbably severe in that entrainment mortality is assumed to be 100%, whereas it has been shown to vary between 30 to 100% depending upon species and life stage. This evaluation concludes that the power plant entrainment and impingement have only a minimal impact on the fisheries of the Great Lakes. This evaluation is responded to by an author of the original paper, who maintains that once-through cooling extracts fish which are not utilized in any way and which are in excess of 25% of the total annual commercial fish havest. (Baker-FRC)
W84-00019

PRODUCTION OF FILTER-FEEDING TRICHOPTERA IN AN IMPOUNDED AND A FREE-FLOWING RIVER,
Royal Ontario Museum, Toronto. Dept. of Entomology.
C. R. Parker, and J. R. Voshell, Jr.
Canadian Journal of Zoology, Vol 61, No 1, p 70-87, 1983. 2 Fig, 8 Tab, 65 Ref.

Descriptors: *Aquatic productivity, *Dam effects, *Ecological effects, Aquatic population, *Food chains, *Zooplankton, Aquatic animals, Environmental effects, Crustaceans, Trophic level, Population dynamics, Reservoirs, Seston, *Virginia, North Anna River, South Anna River.

The productivity of five species of Hydropsychidae and two species of Philoptamidae was examined at two sites on the impounded North Anna River and two sites of the free-flowing South Anna River of Virginia. Total production was highest at the site immediately below the dam (3250.0 kilograms dry weight/ha/yr), while at the other sites production ranged from 94.0 to 515.1 kilograms dry weight/ha/year. Analyses of trophic dynamics, seston energetics, and rates of consumption showed that zooplankton released from the reservoir greatly enriched the seston which corresponded to the size of the zooplankton released from the reservoir and the capture net mesh size of the hydropsychids. The high density of filter feeders below the dam reduces the food quality of the seston and limits production downstream. Detailed biotic interaction which might effect the dynamics of such an ecosystem are also considered. (Geiger-FRC)
W84-00079

SOME HYDROTECHNICAL PROBLEMS RELATED TO THE CONSTRUCTION OF A CAUSEWAY IN THE ESTUARY OF THE PETITCODIAC RIVER, NEW BRUNSWICK: DISCUSSION,
Northwest Hydraulic Consultants, North Vancouver (British Columbia).
V. J. Galay.
Canadian Journal of Civil Engineering, Vol 10, No 1, p 169-170, 1983. 1 Fig, 4 Ref.

Descriptors: *Dam effects, *Silting, *Tidal effects, Estuaries, Drainage, Petitcodiac River, *New Brunswick.

The writer reinforces the conclusions presented in the above titled paper, written by D. I. Bray et al. and published in Canadian Journal of Civil Engineering, Vol. 9, pages 296-307, 1982, with respect

o the rapid siltation of an estuary on the seaward ide after construction of a causeway or other bstructure. In several projects of this type silt has bstructed the gates, making them inoperable, and reventing drainage during low tide and in wet easons. (Cassar-FRC)
W84-00081

NFLUENCE OF A NEW IMPOUNDMENT ON PESTICIDE CONCENTRATIONS IN WARM-WATER FISH, SAYLORVILLE RESERVOIR, DES MOINES RIVER, IOWA, 1977-78,
Minnesota Pollution Control Agency, Roseville.
S. Y. T. Leung, R. V. Bulkley, and J. J. Richard.
Pesticides Monitoring Journal, Vol 15, No 3, p 117-122, December, 1981. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Fish, *Reservoirs, *Pesticide residues, Fate of pollutants, Rivers, Insecticides, Herbicides, DDT, Dieldrin, Heptachlor, Saylorville Reservoir, *Iowa, Des Moines River.

Pesticide concentrations were determined in warm water fish caught above, within, and below the newly impounded (April 1977) Saylorville Reservoir, on the Des Moines River, Iowa, from October 1977 to October 1978. No atrazine, alachlor, or cyanazine were detected in fish samples. Dieldrin generally occurred in greater concentrations than the other insecticides identified, total DDT and its isomers and heptachlor epoxide. Levels of dieldrin and heptachlor epoxide were significantly higher in river carpsucker from the reservoir than from the river. Other fish species (gizzard shad, common carp, channel catfish, white crappie, walleye, and largemouth bass) showed no trends in pesticide levels as related to site of collection. Mean pesticide concentrations (micrograms per kg wet weight) for all fish at the reservoir and downstream stations were: dieldrin, 49-55; total DDT, 65-72; and heptachlor epoxide, 6-9. (Cassar-FRC)
W84-00197

7. RESOURCES DATA

7A. Network Design

INTEGRATING A GROUND WATER DATA RECONNAISSANCE PROGRAM INTO A MINERAL EXPLORATION PROGRAM,
Mobil Coal Producing, Inc., Denver, CO. Environmental Technical Services.
J. M. Kaufman, and T. D. Vandell.
Mining Engineering, Vol 35, No 2, p 137-139, February, 1983. 4 Fig.

Descriptors: *Mineral industry, *Geohydrology, *Exploration, Drilling, Groundwater, Data collection, Water quality, Water level.

Costs may be saved by integrating a groundwater data reconnaissance program into the later phases of mineral exploration. Water data is most easily obtained from exploration holes drilled with rotary drilling equipment using air or water as the drilling fluid. For each borehole a geologic and geophysical log should be kept and water samples collected for analysis. Hydrogeologic data which can be obtained from these studies include static water levels, permeability, air lift production rate, transmissivity, and water quality. (Cassar-FRC)
W84-00096

EVALUATION OF WATER QUALITY SAMPLING LOCATIONS ON THE YUKON RIVER,
Inland Waters Directorate, Vancouver (British Columbia). Pacific and Yukon Region.
P. H. Whitfield.
Water Resources Bulletin, Vol 19, No 1, p 115-121, February, 1983. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Water quality, *Evaluation, *Sampling, Samples, Yukon River, *Alaska, Yukon Territory, Monitoring.

An approach was developed and used to evaluate sampling locations on the Yukon River between Dawson in the Yukon Territory and Eagle, Alaska. Spatial heterogeneities and temporal variations in a number of water quality variables at four locations on the Yukon River were examined to determine an optimum sampling location and to estimate a necessary frequency and density of sampling for long term monitoring. At three of the four study sites it was difficult to obtain representative samples due to the presence of extensive lateral heterogeneities. These heterogeneities occur because of a lack of mixing between the Yukon River and the major tributaries upstream from Dawson. Only one of the sampling locations was spatially homogeneous enough to provide representative samples. Concentration variations over the annual cycle are very large, often as much as two orders of magnitude. Estimates are made of the frequency and density with which samples must be collected to be able to detect a 10% difference between annual mean concentrations. The estimated frequencies are so large that such an undertaking would be impractical. More importantly, the assumptions of this analysis are invalid, and time series analysis of fixed frequency samples is proposed as an alternative that is statistically rigorous and requires fewer samples. (Baker-FRC)
W84-00097

7B. Data Acquisition

SAMPLING ACCURACY OF PIT VS. STANDARD RAIN GAGES ON THE FERNOW EXPERIMENTAL FOREST,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, and J. H. Patric.
Water Resources Bulletin, Vol 19 No 1, p 87-89, February, 1983. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Rain gages, *Measuring instruments, *Rainfall, Gages, Precipitation, Sampling, Standard raingages, Pit gages, Hardwood forest, Forest management, Forestry, *West Virginia.

Catch in standard (unshielded) rain gages exposed 3 feet above the surface of the land was compared with catch in pit (buried) gages exposed 1 inch above the surface. The results of the comparison confirm that pit gages can help to rectify the undersampling of rainfall inherent in conventionally exposed standard gages, in wildland observation as well as the usual weather stations. They confirm also that trees surrounding rain gage openings in the forest provide wind shielding inadequate to correct the undersampling in standard gages. Catch in buried gages may reflect orographic increases in rainfall more accurately too; precipitation is known to increase 4 to 8 cm/yr/100 m of elevation. This relation between elevation and precipitation is undetectable in long-term Fernow data based on catch in standard gages, presumably because it is masked by the undersampling effect of stronger winds at higher elevations. Pit gages caught significantly more rain than did standard gages at each of the four locations tested. Catch increases ranged from 213 to 3.4%. (Baker-FRC)
W84-00114

AUTOMATED PATTERN RECOGNITION OF PHYTOPLANKTON - PROCEDURE AND RESULTS,
Technische Univ., Dresden (German D.R.).
O. Schlimpert, D. Uhlmann, M. Schuller, and E. Hohne.
Internationale Revue Der Gesamten Hydrobiologie, Vol 65, No 3, p 427-437, 1980. 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Automation, *Phytoplankton, *Classification, Asterionella, Fragilaria, Deratium, Melosira, Peridinium, Computers.

Automatic identification of 5 phytoplankton species (Asterionella formosa, Melosira italica, Ceratium hirundinella, Fragilaria crotonensis, and Peridinium bipes) was evaluated using television pictures analyzed by a Robotron 4200 computer. Raster images were subjected to spectral analysis. A feature vector was used to describe the objects independent of their angular position. This permitted characterization in a p-dimension feature space of each genus as a cluster which could be separated from the clusters characterizing other genera by means of discriminance functions. The statistical moments (location and orientation of the separating hyperplanes) required for classification were determined automatically by a learning method. The overall error rate was 6.8%. Errors for individual species were zero for Asterionella, 25% for Fragilaria, and 1-4% for the other 3 species. The rate of rejection (assignment to none of the 5 classes) was 12.8%. The scanning raster used in the study was relatively coarse, (<100 picture elements per colony). (Cassar-FRC)
W84-00300

RESULTS OF TOXIC ACTION OF WATER POLLUTANTS ON DAPHNIA MAGNA STRAUS TESTED BY AN IMPROVED STANDARDIZED PROCEDURE (ERGEBNISSE DER SCHADWIRKUNG WASSERGEFAHRDENDER STOFFE GEGEN DAPHNIA MAGNA IN EINEM WEITERENTWICKELTEN STANDARDISIERTEN TESTVERFAHREN),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
G. Bringmann, and R. Kuhn.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 15, No 1, p 1-6, 1982. 14 Tab, 5 Ref.

Descriptors: *Water pollution effects, *Toxicity, Sublethal effects, Median tolerance limit, Data acquisition.

A largely standardized procedure for testing the potential toxic action of water pollutants as measured by the immobilization of Daphnia magna Straus is presented. Details of the methodology, application, evaluation, and results are discussed. The standardized test strain IRCHA served as a test organism. The stock cultures were fed standardized dry algae, and toxicity testing was performed in a chemically and physically defined standardized culture medium. When evaluating the test results, the medium tolerance limits (EC 50) values of the substances tested were determined according to a mathematically standardized method. The toxicologically relevant range of the EC was determined by establishing the EC 0 and the EC 100. The results of 183 pollutants are listed in tables classified by substance groups. About 30 pollutants were found to toxicologically effective at concentrations of less than 10 milligrams per liter. These pollutants include silver, mercury, copper, thallium, and cadmium cations; dichromate, cyanide, sulphur, arsenate, and selenite anions; such inorganic substances as hydrogen peroxide and ammonium hydroxide; and such organic substances as hydroquinone, 4-nonylphenol, and pentachlorphenol. (Carroll-FRC)
W84-00325

7C. Evaluation, Processing and Publication

GEOPROCESSING - A WATER DISTRIBUTION MANAGEMENT TOOL,
D. K. O'Day.
Public Works, Vol 114, No 1, p 41-43, January, 1983. 3 Fig, 3 Ref.

Descriptors: *Data processing, *Water mains, *Geography, *Water distribution, Dual Independent Map Encoding (DIME), Leakage, Data collections, Urban areas, Maps, Rehabilitation, *Geoprocessing.

Geoprocessing combines geographic analysis and data processing. It can be useful in managing water distribution systems by integrating routine, readily available field data into a geographically oriented data system for network analysis models, water loss control programs, and maintenance/rehabilitation planning. The Dual Independent Map Encoding (DIME) base file provides a computerized description of street networks in 256 U.S. metropolitan areas. An example of geographically processing water utility data features preparation of a summary of water main breaks for each segment of the main in the distribution system, given several thousand water main break reports. This report can identify high break mains, leak prone mains,

and low C-value mains to aid in planning rehabilitation programs. (Cassar-FRC)
W84-00196

8. ENGINEERING WORKS

8A. Structures

EVALUATION OF THE ECONOMIC EFFICIENCY OF THE OPERATION OF A HYDROELECTRIC STATION ON THE BASIS OF SPECIFIC WATER DISCHARGES,
G. S. Kiselev, and A. A. Kuprik.
Hydrotechnical Construction, Vol 15, No 9, p 533-538, 1981. 3 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 24-26, September, 1981.

Descriptors: *Economic efficiency, *Hydroelectric plants, *Specific discharge, Reservoir operation, Operation policies, Electric power production, Flow measurement, USSR.

The economic efficiency of a hypothetical hydroelectric station was calculated by comprising actual specific discharge and specific discharge determined from the assigned operating regime. This procedure compensates for differences in head and daily load assignments. The resulting efficiencies provide a basis for incentives to operate the plants at maximum efficiency. In addition, a group of interconnected hydroelectric and thermal powerplants may be rated for efficiency on a more uniform basis. (Cassar-FRC)
W84-00142

SHANGHAI TUNNEL PROJECTS SPUR CONSTRUCTION INNOVATIONS,
Shanghai Tunnel Construction Co. (China).
W. Z. Xin.
Civil Engineering (New York), Vol 52, No 12, p 36-38, 1982. 4 Fig.

Descriptors: *Tunnels, *Water conveyance, *Piping, Design criteria, Engineering, Water pipes.

Underground construction in soft ground is newly developed in Shanghai. Pipe jacking was introduced into the area over two decades ago for a short sewer tunnel under a woolen mill workshop. The use of pipe jacking spread, and the long distance record comprised the completion of a 518.99 m push of 2600 mm diameter steel pipe under the Yung River. The major technical innovations of long distance pipe jacking include: the introduction of intermediate jacking stations in association with bentonite lubrication to lower the total thrusting force, which increases in direct proportion to the distance of pipe jacking; and the introduction of an articulated shield which facilitated high accuracy both in alignment and grade. The shield used for long distance pipe jacking is a special design, built on three segments with watertight overlapping joints for articulation. The third innovation was the introduction of presssurized face shield with 'shelves' used to support the sandy or clayey ground. Welded steel pipes were used in the long distance projects both for withstanding the high jacking force and external ground pressures and for watertightness. Reinforced concrete pipes have also been developed to withstand the erosive effect of the effluents in long distance sewage piping. (Baker-FRC)
W84-00348

8B. Hydraulics

ON WATER WAVES PRODUCED BY GROUND MOTIONS,
Montpellier-2 Univ. (France). Dept. de Physique Mathematique.
P. C. Sabatier.
Journal of Fluid Mechanics, Vol 126, p 27-58, 1983. 20 Ref.

Descriptors: *Waves, *Model studies, Seismics, Tsunamis, Mathematical equations, Mathematical studies.

A linear and irrotational model is constructed to represent the formation of water waves by ground motions of a sloping bed. A survey of the constant-depth case, given first, helps in understanding the mechanism of formation and, in this oversimplified case, wave propagation away from a source, which is usually very asymmetric. The importance of asymmetry, which produce trapped waves, is illustrated by an estimate of the propagation in a three-dimensional case. The formation of waves by a ground motion on a slope is studied in depth. The problem is reduced to linear integral equations of the first kind. A source-response pair is constructed using an inversion technique. A general approximate solution is derived in both the two and three dimensional cases. Results for the sloping-bottom case are given for small times. They give initial values of surface displacement. They also enable the determination of important physical parameters in the ground motion to be made and the efficiency of wave production to be evaluated. (Baker-FRC)
W84-00021

BEND LOSSES IN DROP INLET SPILLWAYS,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
C. D. Smith.
Canadian Journal of Civil Engineering, Vol 10, No 1, p 1-8, January, 1983. 8 Fig, 6 Tab, 8 Ref.

Descriptors: *Spillways, *Hydraulic loss, *Eddies, Design criteria, Hydraulic design, Spillway channels, Drop inlet spillway, Bend loss.

Several configurations for the 90 degree bend in drop inlet spillways were subjected to hydraulic tests. Cross sections were square and the ratio of the inside radius of the bend to the side dimension of the cross section was 0.5 for each of the 5 designs: (1) curved bend (both sides curved), (2) square bend (both sides angular), (3) outside curve (outside curved, inside angular), (4) inside curve (outside angular, inside curved), and (5) curve and bevel (inside curved and outside beveled). Loss coefficients determined over a range of flow velocities and heads were: curved bend, 0.27; square bend, 1.3; outside curve, 1.29; inside curve, 0.52; and curve and bevel, 0.37. These results show the importance of the inside curve and the unimportance of the outside curve. Construction costs are considerably higher for curved structures than for the square structure. Therefore design can be simplified by omission of the outside curve while retaining the flat bottom as a convenient base for construction. The inside curve design is an economical and effective compromise between the expensive curved design and the inefficient square bend. (Cassar-FRC)
W84-00090

SIZING WATER WELLS FOR GROUND WATER HEAT PUMPS: PART II,
T. E. Gass.
Water Well Journal, Vol 34, No 5, p 36-37, May, 1980. 1 Fig.

Descriptors: *Storage requirements, *Storage tanks, *Water storage, *Pump wells, *Water pressure, Storage capacity, Pumps, Wells, Water demand, Groundwater, Recycling.

The primary purpose of the pressure tank is to ensure adequate water pressure to all house fixtures while providing enough water storage to avoid frequent pump starts and stops. The storage facility must be large enough to meet peak demands while allowing some reserve. The hydropneumatic pressure tank is commonly used for water storage situations where demand does not significantly exceed pump capacity. In some parts of the country, the well itself may provide substantial storage. Storage tanks should be used only in conjunction with a groundwater heat pump. A pump must be sized to meet the water demand of the heat pump and to deliver the water at a desired pressure. A 2,400 gallon tank will meet the continuous demand of the heat pump for 8 hr even if the family diverts 480 gallons of well water for domestic use. To conserve water, some of the water leaving the heat pump may be recycled back to the storage tank. When heating and cooli needs increase, there must be some input groundwater regulated by thermistors. (Geige FRC)
W84-00295

WATER HAMMER WITH BREAKS IN TH CONTINUITY OF THE LIQUID,
L. S. Gerashchenko.
Fluid Mechanics, Vol 10, No 2, p 135-141, 1981. Fig, 11 Ref.

Descriptors: *Water hammer, *Fluid mechani *Pressure spikes, *Pipelines, Pressure, Wat mains, Pipe flow.

New experimental data are given on the pressu spikes in pipes carrying liquids under conditions water hammer with breaks in the continuity liquid. In the experimental setup, the wa hammer originated at the end of a 51.5 mm dian ter, 46.9 m long steel pipe. The pressure variati that occurred during the first phase fitted the Zh kovskiy theory. The pressure reduction period w longer than the impact phase, which suggests on of breaks in continuity. The start of the third wa hammer phase was accompanied by an instan neous high-frequency pressure spike. Such surg with amplitudes decreasing below that of the pr sure spike, are observed at the start of successi add phases that follow periods of breaks of co tinuity. It is concluded from comparison of t experimental results with the theory of develo ment of cavitation that the pressure spikes res from forces generated by simultaneous collapse individual cavitation bubbles upon overall rise pressure in the liquid. By speeding up the fi travel rate it was possible to obtain larger-sc oscillograms of pressure changes immediately f lowing pressure spikes. The pressure curve dur the phase with maximum possible pressure red tion shows up as a horizontal line. At the end the reduction period there appear small press fluctuations, which precede the spikes. Furth study of oscillograms of water hammer produc by closing of a rapid acting slide-valve at the st of a steel pipeline suggests that cavitation bubb during the runs did not collapse simultaneous The findings of this study elucidate the physics the phenomenon and should be treated as a po of departure in detailed quantitative studies water hammer with breaks in continuity. (Bak FRC)
W84-00311

8C. Hydraulic Machinery

TAPPING GROUND WATER FOR HEATI AND COOLING,
Flack and Kurtz, New York.
D. I. Stillman, V. W. Uhl, and M. R. Warfel.
Consulting Engineer (St. Joseph), Vol 60, No 3 59-62, 1983. 2 Fig, 1 Tab.

Descriptors: *Groundwater, *Heating, *Cooli System design, Design criteria, Engineering, Wa resources development.

The cost effectiveness of a ground water sou heat pump system depends on the type of build being heated and/or cooled, ground water av ability, the ground water temperature, and location of the wells in relation to the build Well water source heat pumps take advantage constant source of low-grade heat in the form ground water. The first step in designing a w water source heat pump system is estimating peak heating and cooling loads for the build After test wells have been drilled, a chemical a ysis of the well water must be made. Car analysis of the corrosiveness of the water and materials to be used within the system will en the cost of the piping, heat exchangers, and c denser and evaporator tubes to be kept to a m mum. A case history is described in whic groundwater source heat pump system is to used to heat and cool a 130,000 sq ft commer office building at the Princeton Forrestal Cente Princeton, New Jersey. The basic approach c for formulation of heating/cooling requirem

nd estimates of ground water pumping requirements, a preliminary hydrologic study to assess the otential for developing the required quantities of round water from on-site aquifers, to investigate ossible alternatives for disposal of heat pump discharge water and to define the pertinent regulatory equirements; a field drilling investigation, permit pplication submission and approval, and the intallation of pumps in production wells and other reas. (Baker-FRC)
W84-00024

RETROFIT OF HYDROPOWER CAPACITY AT CONEMAUGH DAM,
Villanova Univ., PA. Dept. of Civil Engineering.
R. A. Chadderton, and J. E. Niece.
Water Resources Bulletin, Vol 19, No 1, p 101-106, February, 1983. 6 Fig, 4 Tab, 4 Ref.

Descriptors: *Design criteria, *Powerplants, Turbines, Hydroelectric power, Dams, Energy, Economic aspects, Hydraulic machinery, Hydraulic equipment, *Pennsylvania, Conemaugh Dam.

Studies were conducted in the Pittsburgh District elative to the addition of hydroelectric power enerating facilities at the existing Conemaugh Dam in Pennsylvania. Selection had already been nade of 8, 10, 15 and 20 megawatt (MW) total nstalled capacities for further study. Appropriate nstallation configuration for each of these four reselected installed capacities was sought, along vith data concerning the conceptual design and ssociated cost estimates for each proposed conguration. Based on the results, the layout preerred consists of the construction of a powerhouse n a portion of the stilling basin apron to enclose nultiple Standard Tube turbines and generators. The number and size of the turbine generator units vill depend on the total installed plant capacity. The cheapest energy, on a cost per kilowatt hour asis, would be derived from a configuration inluding two Standard Tube turbines of 4 MW apacity each. The estimated construction cost for his option was about $1200 per kilowatt. Further consideration must be given to the detailed design f powerhouse roof and bearing walls so as to ssure structural adequacy under spillway dischange, anchoring of stilling basin slabs, and a nodel study for the plan. (Baker-FRC)
W84-00127

SPRING-OPERATED SEMIAUTOMATIC IRRIGATION VALVES,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
A. S. Humpherys, E. Oest, and D. A. Young.
Transactions of the ASAE, Vol 26, No 1, p 134-136, 140, 1983. 5 Fig, 6 Ref.

Descriptors: *Valves, *Mechanical equipment, *Irrigation, Pipelines, Pressure surges, Sprinkler irrigation.

Torsion spring operators for standard low pressure butterfly type irrigation valves are described. These are used with 24 hr timers to semiautomate gated pipe irrigation systems and are particularly well suited for use with flow-though single pipeine systems. They are currently marketed in 150 mm (6 in.), 200 mm (8 in.) and 250 mm (10 in.) diameter sizes. The valve is normally open and is controlled by the time so that it opens at the end of a predetermined closed time period. The valve performed well in field tests in the Grand Valley of Colorado, where it is presently being used. A valve made to operate in the reverse mode by closing when tripped was briefly tested. However, it operated similar to a check valve and closed too suddenly for most conditions. It could be used in this manner at a turnout below a supply ditch, for example, where the upstream pipe length is very short. Otherwise it could create undesirable pressure surges in the pipeline. (Baker-FRC)
W84-00185

PROJECT STUDIES AND RESEARCH WORK CONCERNING BUTTERFLY VALVES AS USED IN WATER POWER STATIONS AND RETARDING BASINS (PLANUNGSKRITERIEN UND FORSCHUNG BEI DROSSELKLAPPEN FUR KRAFTWERKSANLAGEN UND RUCKHALTEBECKEN),
Technische Hochschule, Darmstadt (Germany, F.R.). Fachgebiet Hydraulische Maschinen und Anlagen.
J. Osterwalder.
Wasserwirtschaft, Vol 71, No 12, p 368-372, December, 1981. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Hydroelectric plants, *Hydraulic valves, *Retarding basins, Project planning, Model testing, Valves.

Depending on the scope of application and their specifications, butterfly valves have to fulfill various requirements. Questions relating to plant security, economic aspects, and hydraulic behavior are usually of considerable importance during the planning of water power stations and retarding basins. Experimental investigations with models provide the best solutions to these questions. Although a number of publications deal with information on butterfly valves for water power stations, little information is available concerning the butterfly valves with eccentrical shutters generally used for retarding basins. Recent research in this area has included the development of model tests which enable a judgement regarding such situations in the planning phase, minimizing risks and disagreeable surprises. In many cases, necessary design modifications or changes in construction can be identified early enough to make suitable corrections. The importance of these butterfly valves in retarding basins should not be judged on the bases of their relatively low cost, but rather on the basins of the problems which may result from their failure. (Carroll-FRC)
W84-00313

SMALL HYDRO FROM A SUBMERSIBLE PUMP,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
E. P. Giddens, W. Spittal, and D. B. Watson.
International Water Power and Dam Construction, Vol 34, No 12, p 33-35, December, 1982. 5 Fig.

Descriptors: *Pumps, *Hydroelectric power, Submersible pumps, Hydraulic machinery, Pump turbines, Generators.

A conventional submersible pump and motor, operated in the reverse mode, was tested and approved as a complete, self-contained water turbine and induction generator unit. This system is suitable for power production on the small village scale. The pump was direct-coupled to a single-phase induction motor and generated an autonomous 220V, 50 Hz single-phase supply with a system efficiency nearly the same as in the pumping mode. Improvements are planned to increase efficiency of components on scale-up and provide overspeed control. (Cassar-FRC)
W84-00320

LOW-HEAD WATER MILL LINKED TO CANADIAN GRID.
International Water Power and Dam Construction, Vol 34, No 12, p 76, December, 1982. 2 Fig.

Descriptors: *Turbines, *Water wheels, Hydraulic machinery, Prototypes, Prototype tests, Floats, Hydraulics, Hydraulic design, Hydroelectric power.

Electricity produced by a 6 kW floating watermill was connected to the British Columbia Hydro grid in October 1982. The mill is slung beneath a set of pontoons anchored to the river bed. Three 1.5 m long blades direct the flow. A generator is mounted on the surface. Design of the blades is especially critical because they operate on a vertical axis. The design of the 6 kW machine was based on that of a 4 kW prototype mill which had been operating in the St Lawrence for several months without problems, although the potentially most serious problem, ice, was yet to be encountered. A symmetrical hydrofoil section was selected for the blades, as it is one of the best low drag, high lift sections available. (Cassar-FRC)
W84-00321

FRANCIS TURBINES FOR SMALL-SCALE APPLICATIONS,
Sorumsand Verksted A/S (Norway).
N. Romcke, and J. J. Victory.
International Water Power and Dam Construction, Vol 34, No 12, p 61-65, December, 1982. 6 Fig.

Descriptors: *Turbines, Hydraulic machinery, Materials, Hydraulic design, Francis turbines, Hydraulic equipment, Hydroelectric power.

Francis turbines have been redesigned for use in small hydro schemes. The small-scale turbines use welded steel, cavitation resistant materials, and standardized components. Small units are usually arranged with a horizontal shaft. A standard but flexible design was developed to minimize costs and meet individual requirements. Twelve different models, each representing a specific speed, can be altered slightly to achieve intermediate speeds. Shaft sealing is provided by using 2 or more sealing stages drained off to the tailwater or drainage sump. No lubrication or sealing water is required. Shrinking by the oil pressure method has proven suitable for mounting the runner to the shaft. In some circumstances Francis turbines may be preferred to tubular-type turbines, especially at heads less than 20 m. (Cassar-FRC)
W84-00322

8G. Materials

CALCIUM SULPHATE SCALE REMOVAL DURING OPERATION IN HORIZONTAL TUBE FILM EVAPORATORS,
Hamon-Sobelco, Brussels (Belgium).
J. Moisse.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 169-174, 4 figs. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: Seawater, *Distillation, *Powerplants, Desalination, Horizontal tube film evaporators, Scale removal, Scaling.

Thick scales of calcium sulphate experienced on a horizontal film type evaporator of 1500 cu m/day, operating in the modern power station of FACOA, Venezuela, were easily removed without chemical or mechanical actions, keeping the plant in operation at more than 50% of its rated capacity.
W84-00221

FACTORS AFFECTING THE BRINE SCALING POTENTIAL IN MSF PLANTS,
Albright and Wilson Ltd., Oldbury (England).
K. G. Cooper, L. G. Hanlon, G. M. Smart, and R. E. Talbot.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 175-184, 4 Figs, 2 Tab, 5 Ref. (1st. Vol of the Proc of the Intern Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, *Multistage flash distillation, Brine scaling.

Laboratory studies, using synthetic brine, have shown that it is possible to quantify the thermodynamic driving force for the formation of alkaline scales by a consideration of saturation pH values for the various scaling species. Scaling potential profiles, using this concept, are presented to illustrate this point and demonstrate how the driving force may be measured at various points in the unvented sections of an operating MSF plant.
W84-00222

EROSION-CORROSION RESISTANCE OF COPPER ALLOW C72200 IN SEA WATER CONTAINING SUSPENDED SAND,
Olin Corp., New Haven, CT. Chemicals Div.
N. W. Polan, M. A. Heine, J. M. Popplewell, and C. J. Gaffoglio.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 223-231, 2 Figs, 3 Tab, 10 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Group 8G—Materials

Descriptors: *Desalination, Desalination apparatus, Distillation, *Corrosion resistance, *Copper, Copper alloy C72200.

Copper based alloys have been used frequently in salt water service in applications where thermal conductivity, fouling resistance, and good corrosion performance are required. Under conditions, such as turbulent flow or localized high velocities due to partial tube blockage, a form of accelerated attack known as erosion-corrosion can occur. Many copper base alloys, particularly the cupro nickels, are resistant to this form of attach under normal conditions. In particular, certain alloys such as C72200 have been developed specifically to resist erosion-corrosion. However, another form of erosion-corrosion is sometimes observed in locations where sand becomes entrained with the sea water, for example, in certain Middle Eastern desalting plants and European power generating plants. Previous studies have indicated that the erosion-corrosion resistant C72200 approaches the sand erosion resistant C71640. In addition, temper (and consequent hardness) has proven to be a factor. It appears likely, therefore, that at harder tempers, C72200 may equal or exceed the sand erosion resistance of C71640. Coupled with the excellent erosion-corrosion of the alloy and lower cost due to a much lower nickel content, this new alloy may be an attractive candidate for desalting and heat exchanger use where sand entrainment is a problem.
W84-00227

CORROSION PROBLEMS CAUSED BY BROMINE FORMATION IN MSF DESALINATION PLANTS,
INCO Europe Ltd., Birmingham (England).
J. W. Oldfield, and B. Todd.
In: Desalination, Vol 38, Nos 1/2/3, November 1981. p 233-245, 7 Fig, 25 Ref (1st Vol of the Proc of the Intern Congress on Desalination and Water Reuse, Bahrain, Nov 29-Dec 3, 1981).

Descriptors: *Desalination, Desalination plants, *Corrosion, Multistage flash distillation, , Chlorination, Hydrogen ion concentration, Bromine.

The chlorination of sea water has been considered in detail, with particular reference to the oxidation of bromide ions, already present in sea water, to bromine by the chlorine. Under normal conditions of sea water chlorination, bromide ions will rapidly be oxidized to bromine, hypobromous acid and hypobromite ion, bromine being the predominant form at pH values of 6 and less. The significance of this work to MSF desalination plants is that acid treated plants provide conditions suitable for bromine gas formation in the decarbonator and deaerator. For such plants operating with residual chlorine levels in the range 0.2 to 0.5 ppm the condensates from the steam that has passed through the deaerator into the vent system could well contain between 10-100 ppm Br2; these levels of bromine can cause severe localized corrosion problems with conventional stainless steels. Such corrosion has been observed in practice. Calculations indicate that providing the pH is 6 and the residual chlorine is less than 0.22 ppm at the point of entry to the deaerator, the likely bromine level in the condensate in the vent system will be less than 10 ppm, and this may well be low enough to prevent corrosion of type 316 stainless steel.
W84-00228

STUDIES OF THE LOCALISED-CORROSION BEHAVIOUR OF SOME STAINLESS STEELS, INCOLOY 825 AND TITANIUM IN SEAWATER,
Glasgow Univ. (Scotland). Dept. of Mechanical Engineering.
T. Hodgkiess, and A. Asimakopoulos.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 247-256, 4 Figs, 3 Tables, 11 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, *Corrosion, Multistage flash distillation, Titanium, Chromium.

The localised-corrosion behaviour of several high-grade materials has been investigated in a range of conditions of relevance to desalination plant. Under the conditions studied, no evidence has been found of pitting, crevice corrosion or stress-corrosion cracking in titanium. The remaining materials, all chromium-containing, have exhibited similar immunity as titanium in the least aggressive environments but, to an extent depending upon the material and conditions, they have been found to be susceptible to pitting and crevice corrosion in the more severe conditions featured in this work. The relevance of the observations to distillation-plant operation is discussed.
W84-00229

ACID CLEANING AND PASSIVATION OF POWER PLANT CONDENSERS AND DESALINATION PLANTS,
Rome Univ. (Italy). Ist. di Chimica Applicata ed Industriale.
R. Cigna, A. de Maio, L. Giuliani, and G. Gusmano.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 269-279, 8 Fig, 4 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Cleaning, Corrosion control, Powerplants, *Tubes, Copper, Alloys.

Acid cleaning and passivation treatments of copper alloy tubes are described. The suitability of corrosion monitoring to follow each step of such operation is demonstrated. To regenerate a clean surface on copper alloy tubes after improper conservation or after corrosive conditions during service, an acid cleaning and pre-passivation treatment has proven to be a very useful and industrially viable method. Such a treatment has definite advantages over any mechanical cleaning method as far as complete dissolution of corrosion products with deterioration of the metallic surface is concerned. The pre-passivation protects the exposed surface in case of further conservation and/or descreases surface reactivity during start-up, thereby allowing a uniform growth of corrosion layers. In case of pitting corrosion, the presence of a Cu-BTA salt film acting as a cathodic inhibitor minimizes any impingement attack which could be provided locally by the pitting morphology.
W84-00231

QUALITY CONTROL PROBLEMS IN COPPER ALLOY TUBES MANUFACTURING,
Rome Univ. (Italy). Ist. di Chimica Applicata ed Industriale.
G. Gusmano, and G. Dall'Omo.
In: Desalination, Vol 38, Nos 1/2/3, November 1981, p 281-293, 16 Fig, 4 Ref. (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Bahrain, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination apparatus, *Corrosion, Copper alloy, *Condenser tubes, Tube integrity.

The quality control of copper alloy condenser tubes cannot be limited to mechanical characteristics, microstructure and chemical composition, but should be extended to cover such not yet fully standardized topics as tube integrity and surface conditions. An analysis of possible defects, with particular regard to internal ones and their relevance of tube life is given together with their causes. Problems related to detection of internal defects by means of eddy current test are also discussed.
W84-00232

PRE-SERVICE CORROSION CONTROL IN MULTIFLASH DESALINATION PLANTS,
Atel SRL, Rome (Italy).
L. Giuliani.
In: Desalination, Vol 38, 1/2/3, November 1981, p 295 (Abstract only) (1st. Vol of the Proc. of the Intern. Congress on Desalination and Water Reuse, Nov. 29-Dec. 3, 1981, Bahrain).

Descriptors: *Desalination, Desalination plants, *Multistage flash, *Corrosion control, Preconditioning treatment, Stainless steel, Copper alloys.

Multiflash desalination plants are characterized by large heat exchange surfaces and presence of noble alloys which might be sensitive to localized corrosion attack during manufacturing, transportation and commissioning. To avoid premature failure, all surfaces must be preserved clean and free from corrosion nucleation until the plant starts its normal operation. A detailed analysis is given of possible corrosion causes and available remedies. Some Pre-conditioning treatments are outlined, especially for stainless steel and copper alloys.
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8I. Fisheries Engineering

STUDY OF FISH MANAGEMENT AT THE LG 2 RESERVOIR (TRAVAUX D'AMENAGEMENT PISCICOLE AU RESERVOIR DE LG 2),
Societe d'Energie de la Baie James, Montreal (Quebec).
N. Faubert.
Canadian Water Resources Journal, Vol 7, No 2, p 172-180, 1982. 2 Fig, 2 Ref.

Descriptors: *Reservoirs, *Fisheries management, Reservoir fisheries, Fish populations, Reservoir construction, Reservoir design, Water level fluctuations, James Bay, La Grande Complex, Canada.

In order to determine the likelihood for future reservoirs in the La Grand Complex in northern Canada to be naturally populated by certain species of fish, the Societe d'energie de la Baie James decided to perform a fish management program before the reservoirs are impounded. The program involves deforestation and cleaning of the mouths of some tributaries and littoral sections, which exposes the surface materials more quickly, while preventing the accumulation of ligneous material and the resulting clogging. Building retaining dikes in small bays, such as dike BA-02 at reservoir LG 2, has made it possible to eliminate the effects of fluctuating water levels in the reservoir. In addition, the removal of obstructions from river courses and the creation of fish ways facilitates the movements of fish to sites where they will spawn or feed. (Author's abstract)
W84-00318

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

POLLUTANT-PARTICLE ASSOCIATIONS AND DYNAMICS IN COASTAL MARINE ENVIRONMENTS: A REVIEW,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 17, NUMBER 2
FEBRUARY 1984

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A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 2
FEBRUARY 1984

W84-00351 – W84-00700

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

NATURE OF WATER

Aqueous Solutions and Suspensions

THESIS AND HIGH PERFORMANCE UID CHROMATOGRAPHY OF OMEGA-(3-STITUTED-2-OXO-1-PYRIDYL)-YLSULFONATES FOR USE AS WATER CING COMPOUNDS,
ming Univ., Laramie. Coll. of Arts and Sci-
s.
. Nelson, and D. M. Lenz.
er Research Center Completion Report, Sep-er 1983. 22 p, 2 Fig, 4 Tab, 18 Ref. OWRT A-WYO(1), 14-34-0001-2154.

riptors: *Tracers, Chemical composition, Flu-ence, *Liquid chromatography.

ew compounds for use as water tracers were esized by alkylation of the sodium salts of 3-yl-2-pyridone and 3-carbamoyl-2-pyridone Br (CH sub 2) sub x SO sub 3 super - Na + , where x = 2, 3, and 4. These omega-(3-ituted-2-oxo-1-pyridyl)-alkylsulfonates are gly fluorescent, and can be detected at the per-trillion level. They are chemically stable esist absorption in the environment. The com-ds are designed to be separated by ion-pairing sed phase high performance liquid chromato-ic (HPLC) techniques, with fluorescence de-n. These properties make the compounds ely suited for site-specific water tracers.
-00635

WATER CYCLE

General

CUSSION: ASPECTS OF HYDROLOGY IN PROVINCE OF NORTH SUMATRA, ONESIA,
ld, and J. K. Hall.
eedings of the Institution of Civil Engineers, 2: Research and Theory, Vol 73, No 4, p 829-December, 1982. 1 Fig, 2 Tab, 14 Ref.

riptors: *Hydrology, *Runoff, Sumatra, Indo-, Climatic data, Rainfall-runoff relationships, ydrology, River flow, Evapotranspiration, ds, Groundwater.

above titled paper, published in Proceedings ie Institution of Civil Engineers, Part 2, me 73, pages 85-108, March 1982, prompted a nent by J. R. Wood and M. J. Hall about the ology of West Sumatra. North and West Su-a are similar in physical geography and have ir hydrometric networks. However, climatic neters vary widely in space, time, and degree. Sumatra has an average annual rainfall of + or - 714 mm. Drought can occur in June July. R. B. Bulman raised several questions relationships derived from the rainfall and f data. The authors replied to the comments, g that river flows are governed by the geo-nature of the basins, which are recent volcan-ixed volcanic, old volcanic, and sediments. nt volcanic soil deposits have the greatest ration rates and the least runoff. (Cassar-FRC)
-00351

E OF GLACIERS IN WATER EXCHANGE HE USSR,
. Krenke.
r Resources (English Translation), Vol 9, No 254-262, May-June, 1982. 2 Fig, 2 Tab, 26 Ref. slated from Vodnye Resursy, No 3, p 47-56, June, 1982.

riptors: *Hydrologic cycle, *Glacier mass bal-, *Water exchange, *Runoff, USSR, Basins, ns, Artic Ocean, Caspian Sea, Azov Sea, k Sea, Bering Sea, Water levels, Water supply, pitation, Advection.

The completion of cataloging of the glaciers of the USSR and the development of a method for estimating the average depth of accumulation of moisture in glacial systems will make it possible to evaluate the role of glaciation in water exchange in the USSR. The total mass of USSR glaciers, equal to the volume of water being held in them, is estimated by indirect calculations made by various methods and using available geophysical data at 17,000 billion metric tons, i.e., 17,000 cu km. The 25 cu km of moisture annually accumulated by mountain glaciation and the 12 cu km entering the delayed ice cycle are very small quantities by comparison. Glaciation plays a slightly greater role in the moisture cycle of the mountainous part of Central Asia. Here the resultant advection of moisture to a territory of 485,000 sq km is equal annually to about 520 cu km, and the outflow is 400 cu km. When examining glacial runoff and its significance for the water balance in large basins it is noted that the Arctic Ocean receives 26 cu km of water annually from the insular ice caps. More than 2 cu km of glacial water is delivered to this ocean by rivers. In the runoff of rivers to the Bering Sea and the open part of the Pacific Ocean glacial waters amount to 0.8%, and in the runoff to the Okhotsk Sea to only 0.1%. The Azov and Black Seas annually receive from the USSR territory 1.93 cu km of glacial waters, which is apparently equal to half of the glacial waters in these areas. The Caspian Sea receives 1.23 cu km of glacial waters from the Caucasus, or 0.4% of the total runoff to this sea. The only large basin in the USSR where the role of glacial waters in the structure of the annual water balance is quite noticeable is the basin of the Aral Sea. (Baker-FRC)
W84-00381

THE WORLD OCEAN AND ITS ROLE IN PLANETARY MOISTURE, HEAT, AND SALT EXCHANGE,
V. N. Stepanov.
Water Resources (English Translation), Vol 9, No 3, p 217-237, May-June, 1982. 4 Fig, 10 Tab, 39 Ref. Translated from Vodnye Resursy, No 3, p 4-28, May-June, 1982.

Descriptors: *Oceans, *Ocean circulation, *Water exchange, *Hydrologic budget, *Salinity, Salts, Evaporation, Runoff, Continental runoff, Ocean climates.

The Concept of the hydrosphere as a unified envelope of the earth is valid only in that the waters of the planet are linked by a global cycle. In regions where evaporation predominates over the amount of precipitation an increase in salinity of the surface waters of the ocean occurs; salinity convection develops, causing stratification and many other characteristics of the oceanosphere at low latitudes. At the same time the air is saturated with water vapor which is carried landward, due to which the surplus wetting of tropical territories occurs. Moisture exchange is directly related to salt exchange; this pertains not only to the oceanosphere and atmosphere, but also to land waters. During the action of wind waves, spraying of water occurs, leading to the ejection of salts into the atmosphere. Consideration is also given in this review to the distribution of water and land and the size of oceans, the areas and volumes of waters within the main morphological parts of the ocean bottom, the volumes of characteristic water layers, the exchange of energy and materials and planetary processes, solar energy and its role in global mass transport and redistribution, the cyclic nature of development of planetary processes, moisture exchange of the world ocean and the global hydrologic cycle, evaporation, precipitation, continental runoff, moisture budget of the world ocean surface, freshwater balance in the world ocean, heat exchange of the world ocean and its relation to planetary heat and moisture exchange, absorbed solar radiation, expenditure of heat on evaporation, turbulent heat exchange with the atmosphere, heat balance of oceans, estimations of the exchange of salts of the world ocean with the atmosphere and land, components of salt exchange through the ocean surface, and salt exchange between ocean and land. (Baker-FRC)
W84-00382

EVALUATION OF MAXIMUM LIKELIHOOD PARAMETER ESTIMATION TECHNIQUES FOR CONCEPTUAL RAINFALL-RUNOFF MODELS: INFLUENCE OF CALIBRATION DATA VARIABILITY AND LENGTH OF MODEL CREDIBILITY,
Case Western Reserve Univ., Cleveland, OH.
S. Sorooshian, V. K. Gupta, and J. L. Fulton.
Water Resources Research, Vol 19, No 1, p 251-259, February, 1983. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Calibrations, Maximum likelihood estimates, Leaf River, Mississippi, Streamflow, Runoff, Error analysis.

The performances of two maximum likelihood estimators were compared with the simple least squares (SLS) criterion using the soil moisture accounting model of the U.S. National Weather Service's River Forecast System (SMA-NWSRFS). Data from the Leaf River Basin, Mississippi, included 18 years of precipitation, daily potential evapotranspiration estimates, and mean daily streamflow discharge rates. The maximum likelihood estimators were AMLE, which assumes the presence of first lag autocorrelated homogeneous variance errors, and HMLE, which assumes the presence of uncorrelated inhomogeneous variance errors. HMLE provided more realistic parameter estimates and more reliable forecasts and was less affected by the nature and length of data used for calibration. The SLS and AMLE, similar to each other in performance, were quite sensitive to variability and length of data. (Cassar-FRC)
W84-00397

AUTOMATIC CALIBRATION OF CONCEPTUAL RAINFALL-RUNOFF MODELS: THE QUESTION OF PARAMETER OBSERVABILITY AND UNIQUENESS,
Case Western Reserve Univ., Cleveland, OH.
S. Sorooshian, and V. K. Gupta.
Water Resources Research, Vol 19, No 1, p 260-268, February, 1983. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Calibrations, Maximum likelihood estimates, Leaf River, Mississippi, Streamflow, Runoff, Error analysis.

Problems in automatic calibration of conceptual rainfall-runoff models are reviewed. The most important of these problems is an inability to obtain unique and conceptually realistic parameter sets because of poor properties of the response surface. Most models cannot be properly identified even with synthetic data because of inadequacies in the model structure and in the automatic techniques used for calibration. An analysis of the SMA-NWSRDS model using the simple least squares criterion and the HMLE maximum likelihood estimator showed that the latter greatly improved the parameter estimates obtained through calibration because it has the ability to recognize and account for heteroscedasticity in the residuals. (Cassar-FRC)
W84-00398

UNIQUENESS AND OBSERVABILITY OF CONCEPTUAL RAINFALL-RUNOFF MODEL PARAMETERS: THE PERCOLATION PROCESS EXAMINED,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
V. K. Gupta, and S. Sorooshian.
Water Resources Research, Vol 19, No 1, p 269-276, February, 1983. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Calibrations, Runoff, Streamflow, Percolation, Infiltration, Error analysis.

The failure to obtain unique estimates for the parameters of conceptual rainfall-runoff models can be partly corrected by appropriate reparameterizations of the pertinent model equations. This was done for the percolation equation of the National Weather Service River Forecast System model. A unique optimum parameter set was observed without having affected the original behavior of the

model or altering the conceptual realism of the parameters. These results may be extended to other models and to other structures within the models which cause problems in calibration. (Cassar-FRC)
W84-00399

MODELING EROSION ON LONG STEEP SLOPES WITH EMPHASIS ON THE RILLING PROCESS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W84-00445

PREDICTIVE MODELS FOR ESTIMATING NET RAINFALL AND INTERCEPTION LOSSES IN SAVANNA VEGETATION,
Durban-Westville Univ. (South Africa). Dept. of Geography.
G. Du T. De Villiers.
Water SA, Vol 8, No 4, p 208-212, 1982. 5 Fig, 7 Tab, 16 Ref.

Descriptors: *Model studies, *Rainfall, *Interception, Water loss, Savanna, Vegetation.

Predictive models have been formulated from existing savanna interception data. While interception experimental plot results vary, research indicates that similarities do exist. Independent plot results therefore should be able to be grouped together for application on a regional basis. Throughfall measurements were surprisingly similar under different canopy conditions. Stemflow, highly variable in savanna vegetation covers, is nevertheless predictable from gross rainfall records, and although the average stemflow per storm is often less than 5% of the gross rainfall, it represents a concentrated application of water to soil at a point where conditions are ideal for entry. Sufficient water is added to the soil to cause wetting to considerable depth. For the storms that have been investigated, interception losses for savanna vegetation vary in most cases between 15 and 20% of the gross rainfall, which is far from an insignificant quantity of water. The evaporation rate and the rainfall rate are primary variables influencing this loss. Interception losses in savanna vegetation are not greatly affected by a variety of canopy conditions. Data concerning the rainfall characteristics and the evaporation rate of essential for an accurate estimation of interception losses. (Baker-FRC)
W84-00524

HYDROLOGY OF AREA 15, EASTERN COAL PROVINCE, KENTUCKY AND TENNESSEE,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00543

DESIGN RAINFALL DISTRIBUTIONS FOR THE STATE OF WYOMING,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
P. T. Tyrrell, and V. R. Hasfurther.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132513, Price codes: A03 in paper copy, A01 in microfiche. Water Research Center Completion Report, August 1983. 41 p, 4 Fig, 11 Tab, 26 Ref. OWRT A-036-WYO(1), 14-34-0001-2154.

Descriptors: Rainfall-runoff relationships, *Rainfall distribution, Hyetographs, Flood frequency, Synthetic hydrology, Parametric hydrology, *Flood forecasting, *Design storms, *Wyoming.

Design storm patterns for use in predicting floods by simulating precipitation events in ungaged drainage basins in Wyoming are presented. The design patterns were developed from observed rainfall and are separated into two categories: thunderstorms (events less than four hours in duration) and general storms (events lasting four or more hours). Comparisons of predicted runoff using the new design storms and design storms recommended by the U.S. Soil Conservation Service and the Bureau of Reclamation were made using HEC-1, HYMO, and SCS Triangular Hydrograph and U.S.G.S. distributed routing digital rainfall-runoff models. The new design storms typically produce greater runoff peaks when simulating thunderstorm events, and smaller peaks when simulating runoff from general storms, than those predicted with the established procedures. Instructions describing the use and limitations of the new storm pattern construction method are included.
W84-00638

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2A: SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00661

WATER RESOURCES DATA--VIRGINIA, WATER YEAR 1982,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00662

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 2. EASTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00663

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 1. WESTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00664

WATER RESOURCES DATA FOR ARIZONA, 1981.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00665

WATER RESOURCES DATA FOR PENNSYLVANIA WATER 1981, VOLUME 1. DELAWARE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00666

2B. Precipitation

SELECTED CLIMATIC CHARACTERISTICS OF THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,
Geological Survey, Salt Lake City, UT. Water Resources Div.
S. D. Waltemeyer.
USGS Open-File Report 82-91 (WRI), 1982. 33 p, 22 Fig, 5 Tab, 20 Ref.

Descriptors: *Hydrologic data, *Climatic data, *Regional analysis, *Networks, Monitoring, Oil shale, Precipitation, Air temperature, Evaporation, *Utah, *Colorado, Uinta Basin.

The southeastern Uinta Basin in Utah and Colorado contains large reserves of oil shale, the mining of which could affect the area's water resources. Climatic characteristics of the area, which were evaluated as one phase of a comprehensive hydrologic study, are presented to help provide the means of evaluating the impact of mining on the area's water resources. Data for precipitation, air temperature, and evaporation obtained by the U.S. Geological Survey from October 1974 to September 1978, and similar short-term data obtained by other Federal agencies at sites in and near study area, were tabulated and adjusted to a 19 70 base period. For all sites with incompl records for 1941-70, the data were adjusted relating them to concurrent data collected at c or more long-term National Oceanic and Atm spheric Administration sites. Maps were prepa showing areal variance for normal annual preci tation, normal annual air temperature, and norr annual pan evaporation.. The normal annual p cipitation ranges from less than 8 inches for a tudes under 5,000 feet to more than 20 incl above 9,000 feet. The normal annual air tempe ture ranges from 37 to 47 degrees Fahrenheit a varies inversely with altitude and latitude. T normal annual pan evaporation ranges from 42 60 inches and varies directly with normal ann air temperature. Although not mapped, it is sho that the normal April 1 water content of the sno pack increases from about 5 inches at 7,000 feet about 11 inches at 9,000 feet. In addition, the ye to-year and within-year variances of some clima characteristics are illustrated. The standard er of estimate when relating normal annual precipi tion to altitude is 17%, which is equivalent to t standard error when relating the average for years of observed record at a site to the long-te mean at the site. Thus, it appears that additio observation points would not improve areal cov age unless the observation sites were continued f 5 years or longer. (USGS)
W84-00548

2C. Snow, Ice, and Frost

DOWNWARD WATER MOVEMENT IN FROZEN GROUND, WESTERN ARCT COAST, CANADA,
British Columbia Univ., Vancouver. Dept. of G ography.
J. R. Mackay.
Canadian Journal of Earth Sciences, Vol 20, No p 120-134, 1982. 11 Fig, 1 Tab, 93 Ref.

Descriptors: *Thawing, *Permafrost, *Hydrolog budget, Melting, Frozen ground, Canada, Arc zone.

Field and laboratory evidence is presented whi shows that in summer water can move downwar into the frozen active layer and subjacent perm frost in response to both thermodynamic a gravitational potentials arising during freeze-tha processes. Direct field evidence discussed includ data from drilling and neutron probe loggin which shows a summer increase in the ice conte of the subjacent frozen ground caused by sno melt infiltration in both permafrost and non-perm frost areas. Conditions which favor the downwa migration of water from thawed to frozen grou are examined in terms of thermally induced h draulic gradients, hydraulic conductivity, conte of unfrozen pore water, temperature gradients, i content, and gravity. Some geocryologic implic tions of the summer growth of ice in frozen grou include the effects on water balance calculatio the origin of patterned ground, the acceleration warming of the layer and the top of permafrost, net downslope frost creep component, and upward loss in winter at sites where water regula ly migrates into the top of the permafrost summer. (Baker-FRC)
W84-00353

APPLICATIONS SYSTEMS VERIFICATIO AND TRANSFER PROJECT, VOL. II, OPE ATIONAL APPLICATIONS OF SATELLI SNOW-COVER OBSERVATIONS AND DAT COLLECTION SYSTEMS IN THE ARIZON TEST SITE,
Geological Survey, Phoenix, AZ. Water R sources Div.
For primary bibliographic entry see Field 7C.
W84-00670

2D. Evaporation and Transpiration

LARGE SCALE DEW COLLECTION AS SOURCE OF FRESH WATER SUPPLY,

Univ., Gainesville. Dept. of Mechanical ering.
mary bibliographic entry see Field 3B.
469

Streamflow and Runoff

NAL FLUCTUATIONS OF STAGE AND HARGE IN THE DANISH RIVER SUSA,
Land Development Service, Slagelse. Hyical Survey.
).
Hydrology, Vol 13, No 5, 293-298, 1982. 6

ptors: *Diurnal distribution, *Water levels, s, River stages, Fluctuations, Hydrology, rk, Susa River, River flow, Unsteady flow.

t and regular diurnal fluctuations of stage charge have been observed in the river Susa dry summer periods. The effects of various contributing to the generation of the diurctuations are discussed in this paper. Most of a investigated is gently sloping agricultural onsisting of glacial deposits, clay, silt, and The underground consists mainly of paleoeposits of chalk and sandstone. The groundmagazine in the paleocene deposits is artemost downstream parts of the river valleys. the downstream part of the river there are grass covered meadows adjoining the river. of these riparian zones are waterlogged or noist, even during dry seasons. The largest diurnal fluctuations found usually occur a short period early each summer. In winter re no discernible daily fluctuations. Diurnal tions, although of a smaller size, occur furstream in the main river reach. The time of naximum and minimum varies from place to as well as over the seasons. During periods cipitation regular diurnal fluctuations are absent. (Baker-FRC)
0379

STER MODEL FOR FLOOD ANALYSIS,
e Univ., Lafayette, IN. School of Civil Engig.
ervantes, M. L. Kavvas, and J. W. Delleur.
Resources Research, Vol 19, No 1, p 209ebruary, 1983. 10 Fig, 3 Tab, 23 Ref.

ptors: *Cluster analysis, *Flood peak, *Hyphs, Model studies, Runoff, Precipitation, River, Flood forecasting, Stochastic process.

peaks of a hydrograph were modeled by a vel and two-dimensional nonhomogeneous stochastic process. It is a cluster process of eyman-Scott type and gives the occurrences d generating mechanisms (FGM) at the preion level as the triggers for clusters of flood at the runoff level. The FGMs are studied in of their times of occurence and their vol- The volume of a FGM corresponds to the e of precipitation in the precipitation cluster riginates at the occurrence time of the FGM. precipitation cluster at the precipitation level esented by its origin time and by its volume oint in a time-volume plane. The FGM points time-volume plane of the precipitation level a two-dimensional process with a non-homous rate of occurence. A two-dimensional sub- process is generated at the runoff level. process represents the occurrences of flood as a point in the time magnitude plane deter- by the conditional rate of occurrence. The cal properties of the flood cluster process er of flood peaks) are found in terms of the bility generating functional of the process. two-dimensional parameters are estimated. arison of the rate of occurrence, covariance y, and probability mass function obtained calculations and from data from several sta- in the Ohio River Basin produced good nent. (Cassar-FRC)
0395

RAYLEIGH-JEFFREYS STABILITY OF THERMOHALINE STRATIFIED FLUIDS SUBJECT TO VERTICAL FLOWS,
Technion - Israel Inst. of Tech., Haifa. Energy Engineering Center.
For primary bibliographic entry see Field 3A.
W84-00462

SIMULATED STREAMFLOW DATA FOR NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
E. H. Wiser.
UNC-WRRI Rpt. No 170, December 1981. 41 p, 3 Fig, 6 Ref, 11 Append. OWRT A-093-NC(1), 14-34-0001-7070.

Descriptors: *Streamflow forecasting, Simulation analysis, Simulation, Streamflow, *Water data, Mean flow, Low flow, High flow, Watersheds, *North Carolina, Synthesis, Reservoir regulation.

A system was developed for simulation of streamflow data at any point in a region. The system is know as NCSSARR(North Carolina version of the Streamflow Synthesis and Reservoir Regulation model). NCSSARR is based on the Streamflow Synthesis and Reservoir Regulation (SSARR) Program developed at the North Pacific Division of the Corps of Engineers in Portland, Oregon. Control programming minimizes input requirements to permit a planner with limited hydrologic or computer background to use the system. The system is interfaced with the data storage and retrieval system known as HISARS to provide convenient data access as well as routine processing of the simulated streamflow data. Simulated streamflow data have been obtained for most river basins in North Carolina. Parameters required for the simulation have been obtained by comparing the simulated data with observed data wherever available. After fitting, the simulated data have been compared with observed data with respect to several criteria, including mean flow, low flow, high flow and monthly distribution. The data are in reasonable agreement for most stream gages, implying that the simulated data may be used in lieu of observation wherever the latter are not available.
W84-00492

LINEAR THEORY OF SUBSURFACE STORM FLOW,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. D. Koussis, and L. -T. Lien.
Water Resources Research, Vol 18, No 6, p 1738-1740, December, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Mathematical equations, *Streamflow, *Kinematic wave theory, *Mathematical studies, *Hydrographs, *Storm seepage, Mathematical models, Storm runoff, Surface runoff, Surface flow, Subsurface drainage, Infiltration, Permeability coefficient.

A solution to the subsurface storm flow problem, a special case of the interflow problem connected to streamflow, is developed through linearization of the complete one-dimensional governing equation. Water surface profiles and outflow hydrographs obtained from this mathematical approximation are compared with the exact solution and with the kinematic approximation to this problem for cases in which subsurface storm flow is equated to four times the product of the constant infiltration intensity and the cosine of the bedrock inclination divided by the product of the hydraulic conductivity and the square of the sine of the bedrock inclination. The accuracy and range of applicability of the proposed theory are greater than that of the kinematic theory, and its results are considered satisfactory for cases where the subsurface storm flow is greater than or equal to 0.25 and less than or equal to 1. (Geiger-FRC)
W84-00517

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE LAKE MICHIGAN BASIN, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
B. K. Holmstrom.
USGS Open-File Report 81-1193 (WRI), March 1982. 102 p, 7 Fig, 2 Plates, 3 Tab, 18 Ref.

Descriptors: *Low flow, *Streamflow, *Streamflow forecasting, *Regression analysis, Low-flow frequency, Equations, Baseflow, Evaluation, Flow characteristics, Flow duration, Flow rates, *Wisconsin, Lake Michigan basin.

Low-flow characteristics of streams in the Lake Michigan basin are presented. Included are estimates of low-flow frequency at 30 gaging stations, flow duration at 13 gaging stations, and selected low-flow frequency characteristics at 22 low-flow partial-record stations and 123 miscellaneous sites. Equations are provided to estimate low-flow characteristics at sites where one base-flow discharge measurement is available. The equations were determined from multiple-regression analyses that related low-flow characteristics at gaging stations and low-flow partial-record stations to basin characteristics. Drainage area and base-flow index were the most significant characteristics in explaining the variation in low flow for sites where one low base-flow measurement (flow durations greater than 80%) has been made. The equations and corresponding standard errors of estimate are computed. Low-flow characteristics are not well defined in the Lake Michigan basin. Standard errors for low-flow characteristics at gaging stations, low-flow partial-record stations, and miscellaneous sites are much higher than State averages. The standard errors for the regression equations are also very high. This is due in part to the flow of many streams in the basin approaching 0 ft/s during low base-flow periods. The graphical regression relation lines are steep for stations on these streams and the resulting standard errors are relatively high. (USGS).
W84-00546

THE INHERENT ASYMMETRY OF RIVER MEANDER PLANFORM,
McGill Univ., Montreal (Quebec). Dept. of Geography.
M. A. Carson, and M. F. Lapointe.
Journal of Geology, Vol 91, No 1, p 41-55, 1983. 15 Fig, 3 Tab, 38 Ref.

Descriptors: *Meanders, *Rivers, *Geomorphology, River flow, Symmetry, Asymmetry.

Evidence is presented to demonstrate that most meander loops are asymmetrical and, more important, that the nature of this asymmetry is not random, but well-defined and consistent. That preferred asymmetry should exist in meander loops does not appear to be the result of chance but seems to reflect certain inherent features of flow through bends. Two forms of asymmetry indicative of flow direction are often displayed. One is downchannel delay in the inflection point of meanders, producing traverses which are dominantly convex facing downvalley. The other is upvalley skew in the axis of gooseneck loops. An index of inflection asymmetry is presented and applied to 15 rivers; the data confirm the statistical preference for delayed inflection. An explanation of the phenomenon is offered based on the hydraulics of flow through bends. Of major importance appears to be the persistence downchannel of patterns of helical circulation and the cross-sectional distribution of longitudinal velocity well past the bend that forms them. The upvalley skew of goosenecks is, in many cases, nothing more than an extreme form of convex-downvalley looping, maintained as meanders have increased their tortuosity. Some goosenecks, however, show no delayed inflection and appear to develop from differences in rates of downvalley migration between adjacent meander traverses. It is concluded that the minimum variance theory and the sine-generated model of meanders should now be discarded. (Baker-FRC)
W84-00568

INDEX OF SURFACE-WATER STATIONS IN TEXAS, JANUARY 1982,
Geological Survey, Austin, TX. Water Resources Div.

For primary bibliographic entry see Field 7A.
W84-00643

TIME OF TRAVEL OF THE FLINT RIVER, UTAH DAM TO HIGHWAY M-13, MICHIGAN: AUGUST 4-8, 1981,
Geological Survey, Lansing, MI. Water Resources Div.
T. R. Cummings, and J. B. Miller.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $3.50 in paper copy, $4.00 in microfiche. USGS Open-File Report 82-853, August 1982. 21 p, 12 Fig, 4 Tab.

Descriptors: *Dye releases, *Tracers, *Dispersion, Mixing, *Water pollution sources, *Waste assimilative capacity, Waste dilution, Waste disposal, Flint River, Genesse County, *Michigan.

The tracing of Rhodamine WT dye has provided time-of-travel data for waste-load allocation studies of a 42.8-mile reach of the Flint River at low flow. Dye was injected at two locations in Flint--at Utah Dam and at Grand Traverse Street. From Utah Dam to Grand Traverse Street the mean velocity of flow was 0.1 foot per second; time-of-travel was 35.3 hours. From Grand Traverse Street to Highway M-13, mean velocity was 0.7 foot per second; time-of-travel was 78.8 hours. Time-of-travel for the reach between Utah Dam and Highway M-13 was thus 114 hours. A discharge of equaled or exceeded about 90% of the time was measured at Grand Traverse Street in Flint before dye injection. (USGS)
W84-00647

MAGNITUDE AND FREQUENCY OF FLOODS IN EASTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
D. D. Harris, and L. E. Hubbard.
USGS Water Resources Investigations Report 82-4078, 1983. 39 p, 7 Fig, 4 Tab, 39 Ref.

Descriptors: *Flood frequency, *Peak discharge, Natural flow, Flood forecasting, Analytical techniques, *Oregon, Log Pearson type III.

A method for estimating the magnitude and frequency of floods is presented for unregulated streams in eastern Oregon. Equations relating flood magnitude to basin characteristics were developed for exceedance probabilities of 0.5 to 0.01 (2- to 100-year recurrence intervals). Separate equations are presented for four regions: Southeast, Northeast, North Central, and Eastern Cascades. Also presented are values of flood discharges for selected exceedance probabilities and of basin characteristics for all gaging stations used in the analysis. Included are data for 148 stations in Oregon, 3 stations in northern California, 3 stations in western Idaho, 4 stations in northern Nevada, and 4 stations in southern Washington. Drainage areas used in the analysis range from 0.47 to 11,300 square miles. Also included are maximum discharges for all eastern Oregon stations used in the analysis. (USGS)
W84-00657

FLOODS FROM SMALL DRAINAGE AREAS IN ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00659

2F. Groundwater

DISCUSSION: ASPECTS OF HYDROLOGY IN THE PROVINCE OF NORTH SUMATRA, INDONESIA,
For primary bibliographic entry see Field 2A.
W84-00351

OUTLINES OF THE HYDROGEOLOGICAL CONDITIONS IN THE SUSA-AREA, DENMARK,
Danmarks Geologiske Undersoegelse, Copenhagen.
N. Kelstrup, and K. Binzer.
Nordic Hydrology, Vol 13, No 5, p 279-292, 1982. 5 Fig, 10 Ref.

Descriptors: *Aquifers, *Groundwater recharge, Percolation, Limestone, Greensand, Sand, Lithology, Quaternary deposits, Hydrology, Infiltration, Denmark, Susa catchment.

Archive data and borehole logging were used to study a pre-Quaternarygreensand limestone aquifer at Susa, Denmark. The aquifer was composed of layers of different lithology, i.e., clay marl, lime sand, limestone and hardgrounds, which dip slightly toward the northwest and are cut by faults. The fault zones, together with a fracture system in the top layers of the aquifer caused by ice pressure, localize zones of high hydraulic conductivity. The hydraulic negative boundaries are found in zones of low hydraulic conductivity mainly within the fault blocks. Both the hydraulic gradient and the hydraulic conductivity decrease with depth in the aquifer. The main part of the groundwater flow is thus taking place at the upper part of the aquifer. The hydrogeology of the Quaternary acquifers was studied by means of environmental tritium levels. Depth of penetration of the tritium was found and hydraulic properties such as actual velocity, hydraulic conductivity and leakage factors have been estimated. Point values of infiltration are given for the two localities at 100-150 mm/year. The groundwater recharge to the limestone aquifers underlying the Quaternary deposits are estimated at between 55-105 mm/year. The distribution of the two lithological types is important for determining areas with downward percolation and areas where a hydrological circuit in the upper layers reduces downward percolation. (Baker-FRC)
W84-00373

A DISTRIBUTED GROUNDWATER/SURFACE WATER MODEL FOR THE SUSA-CATCHMENT. PART II - SIMULATIONS OF STREAMFLOW DEPLETIONS DUE TO GROUNDWATER ABSTRACTION,
Technical Univ. of Denmark, Lyngby.
J. C. Refsgaard, and E. Hansen.
Nordic Hydrology, Vol 13, No 5, p 311-322, 1982. 5 Fig, 1 Tab, 2 Ref.

Descriptors: *Aquifer recharge, *Groundwater, *Model studies, Susa catchment, Catchment areas, Denmark, Groundwater abstraction, Confined acquifers, Streamflow.

The distributed groundwater/surface water model as presented has been successfully tested on historical streamflow data from the Koge A catchment, which is heavily influenced by a groundwater abstraction. The physical mechanisms of streamflow depletion due to groundwater abstraction in catchments where a confined acquifer is overlaid by Quaternary drift deposits have been discussed and illustrated by some simulation results. The large scale effects of a groundwater abstraction on the recharge and steamflow are illustrated. The relative streamflow depletion has been shown to vary considerably from one catchment to another and to depend heavily on the size of the groundwater abstraction. Consequently it is not possible to assign a general streamflow depletion curve, neither to the entire Susa area nor to the individual sub-catchments. For confined acquifers it was found that the location of pumping wells in practice has negligible influence on the streamflow depletion. (Baker-FRC)
W84-00377

A DISTRIBUTED GROUNDWATER/SURFACE WATER MODEL FOR THE SUSA-CATCHMENT, PART I - MODEL DESCRIPTION,
Technical Univ. of Denmark, Lyngby.
J. C. Refsgaard, and E. Hansen.
Nordic Hydrology, Vol 13, No 5, p 299-310, 1982. 8 Fig, 12 Ref.

Descriptors: *Model studies, *Groundwater recharge, Catchment areas, Susa-catchment, Denmark, Evapotranspiration, Streamflow, Hydrology, Aquifers.

A distributed hydrological model has been developed for the Susa catchment, covering about 1,000 sq km of Zealand, Denmark. The landscape is a moraine type formed by glaciers during the last glacial period. The pre-Quaternary aquifer consists of Paleocene deposits and Danian limestone. It is overlayered by glacial deposits, predominantly consisting of moraine clay, yet with some few areas with sandy soil. The model gives a physically based description of the main processes in the entire land phase of the hydrological cycle. The model simulates seasonal as well as year-to-year variations in the hydrological regime of the catchment as a consequence of changing hydro-meteorological and climatological conditions as well as of the influence of man. Almost all the model parameters are physical parameters such as transmissivities, storage coefficients, topographical data, field capacity, and leaf area index. The model has general applicability in areas with similar hydrogeological conditions. This would be the case for a low confined aquifer with relatively large transmissivities overlayered by low permeable saturated deposits and the phreatic surface rather close to terrain. Calibrations and test simulations have been presented for the Susa catchment with respect to hydraulic heads of the confined aquifer, stream flow and soil moisture. Seasonal and year-to-year variations in the hydrological regime have been considered. (Baker-FRC)
W84-00378

LONG-TERM VARIATIONS OF GROUNDWATER RESOURCES OF THE NORTHERN HEMISPHERE,
R. K. Klige, and V. S. Kovalevskii.
Water Resources (English Translation), Vol 9, No 3, p 263-271, May-June, 1982. 6 Fig, 1 Tab, 23 Ref. Translated from Vodnye Resursy, No 3, p 57-66, May-June, 1982.

Descriptors: *Groundwater management, *Water resources development, *Climatology, USSR, United States, Runoff, Rivers, Water supply, Water demand, Forecasting, Mathematical equations, Water levels.

The long-term trend of recharge of groundwater resources was studied using data from chronological runoff series occurring mainly during the winter low-water period at which time rivers are fed primarily by groundwaters. The data were collected from more than 1000 gauging stations over 15-80 years, with the bulk of the series having a duration of 25-40 years. As a result of the study a complex equation was ultimately derived for calculating variations of the groundwater level and the deviations from them of the mean long term value during 1929-1970, taking into account both climatic changes and the anthropogenic effect expressed in world water consumption. At present long-term variations of groundwater resources are related 80-90% to climatic factors. The equation permits reconstruction of the variation of the groundwater levels during the period for which there are data on the basis of the parameters figuring in it from 1893-1975 and even forecasting their variation within 12 years, 1976-1987, with consideration of the lag time. The noted general trends of the long-term variation of groundwater resources agree well with a number of other natural processes such as the retreat of glaciers and shoaling of closed lakes and the increase of the level of the World Ocean as well as the decrease of land water supplies and the analogous increase of water supplies in the ocean. It is concluded that, if the current climatic conditions stay the same, a further decrease of groundwater resources is possible. This process can be intensified considerably during warming of the climate under the effect of further anthropogenic influences on it. (Baker-FRC)
W84-00380

RECHARGE FROM AN EPHEMERAL STREAM FOLLOWING WETTING FRONT ARRIVAL TO WATER TABLE,
Ministry of Agriculture and Water, Riyadh (Saudi Arabia).
M. J. Abdulrazzak, and H. J. Morel-Seytoux.

r Resources Research, Vol 19, No 1, p 194-
February, 1983. 7 Fig, 33 Ref.

riptors: *Ephemeral streams, *Recharge,
lands, Wetting, Infiltration, Groundwater
rge, Aquifers, Water table, Groundwater
d.

the infiltration wetting front from a river bed
ephemeral stream in flood reaches the shal-
vater table, the rate of recharge, which is also
f infiltration, is affected by the development
roundwater mound. The effect is practically
diate if the water content behind the wetting
is close to saturation. An approximate analyt-
olution is developed in that case, which pre-
the time dependence of the recharge rate.
arison with experimental results in th labora-
shows that the solution is excellent in spite of
ssumptions necessary in the derivations. As
as the ratio of river width over depth to water
exceeds 2 and as long as the ratio of initial
ated thickness over depth to the water table
ds 2.5, the analytical solution is essentially
. Under most field conditions these ratios are
y exceeded. Consequently, the predictive
ion for the time dependence of the recharge is
quite simple to use and adequately accurate
eld applications. (Author abstract)
00390

**W TOWARD STORAGE TUNNELS BE-
TH A WATER TABLE 1. TWO-DIMEN-
NAL FLOW,**
Aviv Univ. (Israel). Faculty of Engineering.
al, and G. Dagan.
r Resources Research, Vol 19, No 1, p 241-
February, 1983. 6 Fig, 1 Tab, 13 Ref.

riptors: *Water table profiles, *Tunnel hy-
ics, *Underground storage, Storage gallery,
vation, Groundwater movement, Unsteady
Cavern flow.

mputer program was developed for the two-
nsional unsteady flow of water beneath a
r table toward parallel tunnel-shaped caverns
vated in saturated rock of low permeability for
urpose of storing oil or LPG. A numerical
ne, based on the boundary integral elements
od, was used to determine the water table
on, the inflow to the galleries, and the velocity
ne perimeter. Both oil-filled and air-filled cav-
were considered. While the shape of the gal-
s was constant, the spacing between them and
distance to an impervious bottom were varied.
erical results permitted calculation of the time
ired for the water table to drop from its initial
ion to the gallery top or to the product level,
water velocity on the gallery perimeter, and
otal inflow to the gallery. The dimensionless
city of descent of the water table above and
the top of the cavern was practically constant
insensitive to geometry. The dimensionless
required for the free surface to drop from the
rn top to the height near that of the oil level
also practically constant. The influence of the
zontal impervious boundary was negligible.
sar-FRC)
-00396

**PERIMENTAL INVESTIGATION ON IRRE-
RSIBLE CHANGES OF HYDRAULIC CON-
CTIVITY ON THE SEAWATER-FRESH-
TER INTERFACE IN COASTAL
UIFERS,**
zmann Inst. of Science, Rehovoth (Israel).
t. of Isotope Research.
C. Goldenberg, M. Magaritz, and S. Mandel.
er Resources Research, Vol 19, No 1, p 77-85,
ruary, 1983. 5 Fig, 4 Tab, 46 Ref.

criptors: *Saline-freshwater interfaces, *Hy-
lic conductivity, *Coastal aquifers, Saline
er intrusion, Aquifer properties, Clays, Perme-
ity, Fate of pollutants.

nges in hydraulic conductivity of Israeli coast-
ediments (<5% clay) produced by flushing
h seawater followed by fresh water were stud-
in laboratory columns. Hydraulic conductiv-
ities decreased by a maximum of 0.1 to 0.001 of the original values whenever seawater was flushed from the soil by fresh groundwater. Subsequent flushing with seawater did not significantly restore the original hydraulic conductivities. Using synthetic waters with CaC12 and NaC1 at the same ionic strengths as the natural waters showed that the decrease in hydraulic conductivity was caused by an incipient stage of gel formation. The small water-clay bodies closed the spaces between pores. Results show that a shift of the seawater-fresh water interface in an aquifer containing even a small percentage of clays can create a relatively permanent, almost impermeable boundary in the region of the interface. Attempts to change this interface position by injecting fresh water would likely produce an impermeable boundary within a short time. (Cassar-FRC)
W84-00403

**THREE-DIMENSIONAL STOCHASTIC ANAL-
YSIS OF MACRODISPERSION IN AQUIFERS,**
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 5B.
W84-00408

**REPORT ON GROUND WATER DEPEND-
ENCE IN NEW YORK STATE.**
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
1981. 47 p, 2 Fig, 3 Tab, 1 Append.

Descriptors: *Groundwater availability, *Groundwater depletion, *Groundwater storage, *Aquifers, *Aquifer systems, Available water, Groundwater basins, Aquifer management, Water supply, Water use, Water users, Aqueducts, *New York.

Recently, attention has focused on averting the possible degredation of New York State's groundwater resources. Toward this end, it must be determined which areas use groundwater as a significant source of portable water, and where the major aquifers are located. This report describes the groudwater use of three geographic areas of New York State: Long Island, New York City and upstate New York. On Long Island, the population of the counties of Nassau and Suffolk are 99.88% dependent on groundwater, while New York depends for the most part on surface water for its supply. The New York City aqueduct system supplies 93% of the population. In upstate New York, the availability of groundwater as a source of drinking water varies widely from area to area. Approximately 36% of the upstate population of 7,880,000 uses groundwater as their source of drinking water. The eighteen primary aquifers in New York State are in unconsolidated sand and gravel deposits. To determine their locations, source and treatment, files were searched for groundwater supplies serving populations of 8,000-10,000 or for supplies serving smaller populations of 5,000-6,000 with both surface and groundwater usage. These records were then used in conjunction with USGS reports and county water supply maps. (Garrison-Omniplan)
W84-00499

**PRELIMINARY APPRAISAL OF THE HY-
DROLOGY OF THE BLOCKER AREA, PITTS-
BURG COUNTY, OKLAHOMA,**
Geological Survey, Oklahoma City, OK. Water Resources Div.
M. V. Marcher, D. L. Bergman, J. D. Stoner, and S. P. Blumer.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $12.00 in paper copy, $5.00 in microfiche. USGS Open-File Report 81-1187 (WRI), 1981. 48 p, 9 Fig, 14 Tab, 13 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Surface water, *Water quality, Groundwater movement, Groundwater recharge, Wells, Water level, Streams, Rocks, Strip mining, Chemical analysis, *Oklahoma, Pittsburg County, Blocker.

Bedrock in the Blocker area of southeastern Oklahoma consists principally of shale, siltstone, and sandstone of the Boggy and Savanna Formations of Pennsylvanian age. These rocks have been folded to form the Panther Mountain syncline on the south and the Kinta anticline on the north. Alluvium along streams is less than 15 feet thick and consists mainly of sandy silt. Water in bedrock is under artesian conditions. Well depths range from 11 to 213 feet and average 75 feet. In 86% of the wells measured, the water level was less than 30 feet below the land surface. Because the rocks have minimal permeability, well yields probably are less than 5 gallons per minute. Ground water is commonly a mixed cation bicarbonate type with dissolved solids ranging from about 300 to 2,000 milligrams per liter. No relationship between water chemistry and well depth or geographic distribution is apparent. Streams in the area are ephemeral and there are extended periods of no flow. Blue Creek was dry 30% of the time during 1976-80 and had flows of less than 0.1 cubic foot per second for at least 80 consecutive days. Stream water is generally a mixed cation sulfate type. The maximum dissolved-solids concentration determined in stream water was 3670 milligrams per liter. Maximum suspended sediment discharge, in tons per day, was about 235 for Blue Creek, 40 for Blue Creek tributary, and 630 for Mathuldy Creek. Silt-clay particles (diameters less than 0.062 millimeter) are the dominant sediment size. Surface mining for coal undoubtedly will have some effect on the environment. The most likely deleterious effects are increased sediment loads in streams and increased mineralization of stream waters. However, these effects should be of only limited extent and duration if appropriate mining and reclamation practices are followed. (USGS)
W84-00540

**WATER RESOURCES OF THE GIG HARBOR
PENINSULA AND ADJACENT AREAS, WASH-
INGTON,**
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00544

**HYDROLOGIC DATA FOR THE POTOMAC
FORMATION IN NEW CASTLE COUNTY,
DELAWARE,**
Geological Survey, Dover, DE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00545

**EFFECTS OF UNDERGROUND MINING AND
MINE COLLAPSE ON THE HYDROLOGY OF
SELECTED BASINS IN WEST VIRGINIA,**
West Virginia Geological and Economic Survey, Morgantown.
W. A. Hobba, Jr.
West Virginia Geologic and Economic Survey Report of Investigation RI-33, 1981. 77 p, 57 Fig, 3 Tab, 24 Ref.

Descriptors: *Base flow, *Subsidence, *Mine drainage, *Surface-groundwater relations, Geologic fractures, Permeability, Water table, Observation wells, Runoff, Hydrologic budget, *West Virginia.

The effects of underground mining and mine collapse on the hydrology of an area where the mined bed of coal lies above major streams, and in another area where the bed of coal lies below major streams, are described. Subsidence cracks at land surface generally parallel predominant joint sets in the rocks. The mining and subsidence cracks cause increased infiltration of precipitation and surface water, decreased evapotranspiration, and higher base flows in some small streams. Groundwater levels in observation wells in under-mined areas fluctuate as much as 100 feet annually. Both gaining and loosing streams are found in under-mined areas. Mine pumpage and drainage generally cause diversion of water underground from one basin to another. Areal and single-well aquifer tests indicated near-surface rocks have higher transmissivity values in a mine-subsided basin than in unmined basins. Increased infiltration and circulation through near-surface rocks increases dissolved

mineral loads in streams, as do treated and untreated contributions from mine pumpage and drainage. Abandoned and flooded underground mines make good reservoirs because of their increased transmissivity and storage. Subsidence cracks were not successfully detected by thermal imagery, but springs and seeps were detected and mapped. (USGS)
W84-00547

GEOHYDROLOGY OF PRINCIPAL AQUIFERS IN THE REPUBLICAN RIVER BASIN, KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00549

POSITION OF THE SALTWATER-FRESHWATER INTERFACE IN THE UPPER PART OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA, 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00550

THICKNESS OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00551

TOTAL HARDNESS OF WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00595

SULFATE CONCENTRATION IN WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00596

THICKNESS OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00597

GEOLOGY AND CONFIGURATION OF THE BASE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00598

CONFIGURATION OF THE BASE OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00599

GEOLOGY AND CONFIGURATION OF THE TOP OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00600

HYDROLOGY OF THE FLORIDIAN AQUIFER IN NORTHWEST VOLUSIA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. T. Rutledge.
USGS Water-Resources Investigations, Open-File Report 82-108, 1982, 165 p, 51 Fig, 1 Map, 10 Tab, 13 Ref.

Descriptors: *Aquifer, Recharge, Discharge, Irrigation, *Irrigation wells, *Drawdown, Sinkholes, Flow-net analysis, Water budget, Saltwater intrusion, Aquifer testing, *Florida, Northwest Volusia County, *Floridan aquifer.

The characteristics of the Floridan aquifer in northwest Volusia County and the effects of fernery irrigation withdrawals from the Floridan aquifer were studied. The large irrigational withdrawals, especially in winter months when spray irrigation is used for freeze protection, introduce problems such as the potential for saltwater intrusion, the temporary loss of water in domestic wells caused by large potentiometric drawdown, and increased sinkhole activity. Average ground-water irrigational withdrawal is 8.1 million gallons per day while peak withdrawal rate is 300 million gallons per day during freeze-protection pumpage. Transmissivities of the Floridan aquifer range from 4,500 to 163,000 feet squared per day. Highest transmissivities are in the DeLeon Springs area and the lowest are in the east Pierson area. The drawdown in the Pierson area at the end of one intense pumpage exceeded 30 feet over a 4.4 square mile area. A significant amount of the withdrawn water was replaced by leakage during the pumping period. No long-term residual drawdown has occurred. Sinkhole activity has been increased by the temporary increase in load on the aquifer's skeletal structure during intense potentiometric drawdowns. There is no evidence of saltwater intrusion, but a monitoring network for future early detection is suggested. (USGS)
W84-00601

COMPILATION OF SELECTED GROUND-WATER-QUALITY DATA FROM THE SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00604

GROUND-WATER DATA FOR SELECTED COAL AREAS IN WESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00606

GROUND WATER RESOURCES OF THE GLACIAL-OUTWASH ALONG THE WHITE RIVER, JOHNSON AND MORGAN COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 4B.
W84-00609

AVAILABILITY AND QUALITY OF WATER FROM THE DAKOTA AQUIFER, NORTHWEST IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00611

GROUND-WATER RESOURCES IN THE HOOD BASIN, OREGON,
Geological Survey, Portland, OR. Water
sources Div.
S. J. Grady
USGS WRI/Open-File Report 81-1108, 1983
12 Fig, 2 Tab, 2 Maps, 25 Ref.

Descriptors. *Aquifers. *Groundwater, *B
Confined water, Observation wells. *Potent
tric levels, Geology, *Overdraft, Specific cap
Hydrologic properties, Storage coefficient,
Water quality, *Oregon, Columbia River,
Basin, Cascade Range.

The Hood Basin in north-central Oregon co
of about a 1,035-square-mile area underlai
Miocene to Holocene age volcanic, volcanic
sedimentary rocks, and unconsolidated surfici
posits. The most important aquifer is the Col
River Basalt Group, a unit that underlies m
the basin and probably exceeds a thickness of
feet wherever it is present. By 1980, only the
1,000 feet or less of the formation has been d
oped for water supplies. Most of this develop
is in the semiarid eastern half of the basin. We
the aquifer unit generally yield from 15 to
gallons per minute and a few yield as mu
3,300 gallons per minute. Other aquifer units i
basin have more limited areal extent and sm
saturated thickness than does the Columbia
Basalt Group. Generally, these units are capal
yielding from a few to a few hundred gallon
minute to wells. Most of the ground water i
basin is chemically suitable for domestic, irriga
or other uses. Some ground water has objec
able concentrations of iron (0.3 to 6.4 mg/l)
manganese (0.05 to 1.2 mg/l) or is moderately
to very hard (60 to 260 mg/l) as calcium ca
ate. (USGS)
W84-00613

**GROUND-WATER PUMPAGE IN NAS
COUNTY, LONG ISLAND, NEW YORK,
77, INTRODUCTION AND USER'S GUIDE
THE DATA COMPILATION,**
Geological Survey, Syosset, NY. Water Reso
Div.
For primary bibliographic entry see Field 7C.
W84-00614

GROUND-WATER DATA FOR GEORGIA,
Geological Survey, Doraville, GA. Water
sources Div.
S. E. Matthews, W. G. Hester, and M. P. O'By
USGS Open-File Report 81-1068, 1981. 94 p
Fig, 24 Ref.

Descriptors: *Groundwater, *Water le
Aquifers, *Georgia, Water quality, *Groundw
levels, Groundwater quality.

More than 2,000 water-level measurements m
in Georgia in 1980 provided the basic data for
report. Daily mean water-level fluctuations
trends are shown in hydrographs for the prev
year and fluctuations of the monthly mean w
level are shown for the previous 10 years in sel
ed observation wells in Georgia. Monito
ground-water levels is essential to the understa
ing of storage changes in a ground-water reser
or aquifer. Fluctuations and long-term trend
water levels occur as a result of recharge to
discharge from the reservoir. Mean annual w
levels across Georgia were from 1.92 feet highe
12.61 feet lower in 1980 than in 1979, and in so
areas were the lowest on record. (USGS)
W84-00615

**FAULT SEVERING OF AQUIFERS A
OTHER GEOLOGICALLY CONTROLL
PERMEABILITY CONTRASTS IN THE BAS
MOUNTAIN INTERFACE, AND THE IMP
CATIONS FOR GROUND WATER RECHAR
TO AND DEVELOPMENT FROM THE MAJ
ARTESIAN BASINS OF WYOMING,**
Wyoming Univ., Laramie. Dept. of Geology
Geophysics.
P. W. Huntoon.
Available from the National Technical Informat
Service, Springfield, VA 22161 as PB84-1324
Price codes: A04 in paper copy, A01 in microfic

Research Center Completion Report, June
7 p, 14 Fig, 3 Tab, 45 Ref. OWRT A-034-
), 14-34-0001-2154.

tors: *Groundwater recharge, Geohydro-
eologic fractures, Cavitation, Permeability,
n basins, *Aquifers, Paleozoic aquifers,
severing, *Wyoming, Foreland basin, Lara-
rust faults.

echarge areas for the major Paleozoic
in the Wyoming foreland basins fall into
road classes ranked from least to most effi-
hydraulic interconnection with the aquifers
asins: (1) fault severed, (2) continuous ho-
s, and (3) obliquely faulted. The fault sev-
d continuous homoclines classes each en-
s slightly less than half the basin perimeters
aking these types very common. Recharge
deep basins is precluded along the fault
boundaries. Consequently independent cir-
systems develop in the hanging wall
mountainward from the basin perimeter.
f the recharge water which enters the re-
areas along the homoclinal margins is re-
from the aquifer before entering the deep
the basin. This results because the diagene-
esses of recrystallization, cementation, and
tion have operated to reduce or destroy
bility basinward from the recharge areas
he recharge areas became differentiated
ne basin proper. In both the fault severed
moclinal margin cases, recharge along the
erimeters is precluded or diminished over
bilities determined for the aquifers from the
e areas. The consequences of this finding
ofold: (1) development of ground water
e Paleozoic rocks in the interior parts of the
ve Wyoming artesian basins is largely unfa-
, and (2) developers are forced to limit their
for the best prospects to the recharge zones
he perimeters of the basins. The immediate
: (1) the target drilling areas are dramatical-
ced to a small percentage of the basin
s, and (2) development in the recharge areas
es with existing surface water rights.
0636

**YDROLOGY AND EFFECTS OF WATER
N THE BLACK MESA AREA, NAVAJO
IOPI INDIAN RESERVATIONS, ARIZO-**

gical Survey, Tucson, AZ. Water Resources

ychaner.
Open-File Report 81-911, July 1981. 66 p,
3 Tab, 25 Ref.

ptors: *Groundwater, *Aquifers, *Aquifer
teristics, *Hydrologic budget, *Computer
, Indian reservations, Arid lands, Observa-
ells, Coal mines, Slurries, Planning, *Arizo-
vajo Sandstone, Navajo Indian Reservation,
ndian Reservation, Black Mesa area.

ain source of water in the 5,400-square-mile
Mesa area is the N aquifer, which consists of
avajo Sandstone and underlying Kayenta
tion and Wingate Sandstone. Water is under
ed conditions in the central 3,300 square
Transmissivity is less than 1,000 feet squared
y. Storage coefficient is less than 0.0004 in
nfined part of the aquifer and at least 0.1 in
nconfined part. Recharge is about 13,000
et per year, and storage at equilibrium,
was before 1965, was at least 180 million
et. Ground-water withdrawals were less
00 acre-feet per year before 1970 and in-
d to 5,300 acre-feet per year 1976-1979. By
municipal-supply pumpage is expected to
l that for a coal-slurry pipeline. Water levels
leclined throughout the confined part of the
. Decline of more than 100 feet was calcu-
or an area of 200 square miles through 1979
as projected for 440 square miles through
n the unconfined part, project declines aver-
ess than 1 foot. If pumping for coal slurry
d, most of the decline would recover within
rs. (USGS)
0642

WATER RESOURCES OF THE BLACK HAND SANDSTONE MEMBER OF THE CUYAHOGA FORMATION AND ASSOCIATED AQUIFERS OF MISSISSIPPIAN AGE IN SOUTHEASTERN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
S. E. Norris, and G. C. Mayer.
USGS Open-File Report 82-170, 1982. 95 p, 18 Fig, 3 Tab, 17 Ref.

Descriptors: Hydrogeology, *Aquifer characteristics, Water resources, Groundwater movement, Specific capacity, Transmissivity, *Ohio, Coal hydrology, Black Hand Sandstone Member of the Cuyohoga Formation.

The Black Hand Sandstone Member of the Cuyahoga Formation and associated acquifers of Mississippian age, including the Allensville Conglomerate Member of the Logan Formation, (both members of the local usage) were investigated in a 1,500-square-mile area in southeastern Ohio. These aquifers are the chief sources of water beneath the coal-bearing rocks of the Pennsylvanian System and are widely use for farm and home requirements. The aquifers crop out in the western part of the area and dip southeastward 35 feet per mile. At Lake Hope, in northeastern Vinton County, the aquifers are the deepest sources of ground water in Ohio, occurring at depths locally exceeding 700 feet. At McArthur, in Vinton County, the aquifers yield about 300,000 gallons per day for municipal and industrial use, but withdrawal has been accompanied by declining ground-water levels during the past 10 years in a 10-square-mile area. (USGS)
W84-00644

WATER RESOURCES OF THE ZUNI TRIBAL LANDS, MCKINLEY AND CIBOLA COUNTIES, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
B. R. Orr.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $26.00 in paper copy, $4.00 in microfiche. USGS Open-File Report 82-1013, 1982. 173 p, 25 Fig, 5 Tab, 34 Ref.

Descriptors: *Groundwater resources, *New Mexico, *Aquifer characteristics, *Water wells, Water quality, Springs, Hydrogeology, *Zuni Indian Reservation, Zuni Mountains, McKinley County, Cibola County, Well and spring inventory.

The sandstones and limestones of the Glorieta-San Andres aquifer and sandstones within the Chinle Formation provide most of the municipal, stock, and domestic water supply to the Zuni Indian Tribe in west-central New Mexico. Both aquifers are recharged at outcrops in the Zuni Mountains, and their hydraulic conductivity is significantly enhanced by fractures in the sandstones and by fracture-solution openings in the carbonate rocks. The range of well yields, from 5 to 150 gallons per minute, is attributed to fracture frequency, continuity, and distribution controlled by regional uplift and folding. Water in the Glorieta-San Andres aquifer is enriched in calcium and sulfate, and dissolved-solids concentrations range from 389 to 994 milligrams per liter. Water in the sandstones of the Chinle Formation is enriched in sodium and bicarbonate, and dissolved-solids concentrations range from 215 to 1,980 milligrams per liter. The Bidahochi Formation, a loosely consolidated sand and gravel unit mantling western parts of the reservation, could provide an additional source of water chemically suitable for most uses. Preliminary seismic-reflection studies showed a buried drainage system eroded in Triassic bedrock underlying the Bidahochi. Filled channels may contain sufficient saturated material to supplement existing water supplies. (USGS)
W84-00646

GROUND-WATER APPRAISAL OF THE PINE BUSH AREA, ALBANY COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
D. S. Snavely.
USGS Water-Resources Investigations Report 82-4000, 1983. 64 p, 11 Fig, 8 Tab, 10 Ref.

Descriptors: *Aquifer characteristics, *Sand aquifers, *Groundwater availability, Water table, *New York, Pine Bush, Albany County, Glacial lake, Albany, Groundwater model, Road salt, Water quality.

The 32-square-mile central part of the Pine Bush was studied to determine the availability of ground water in the surficial sand and to assess the quality of the water, especially with respect to phosphorous, nitrogen, and chloride. The surficial sand is from 5 to 150 feet thick and has a hydraulic conductivity of 68 feet per day. Recharge is solely by precipitation. Depth to water is about 10 feet but ranges from 5 to 20 feet locally. The water table and total precipitation have been declining since 1979. A computer model was used to simulate drawdowns that would be produced by pumping the aquifer at various rates. Results indicate that a single well could yield from 150 to 600 gallons per minute, depending on hydraulic conductivity, which was simulated at 25, 50, and 100 feet per day, allowing a maximum drawdown of 80% of total saturated thickness. Ground water contained low phosphorous (maximum of 0.04 mg). (USGS)
W84-00655

ANALYSIS OF THREE TESTS OF THE UNCONFINED AQUIFER IN SOUTHERN NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
J. B. Lindner, and T. E. Reilly.
USGS Water Resources Investigations Report 82-4021, 1983. 65 p, 10 Fig, 7 Tab, 12 Ref.

Descriptors: *Groundwater, Mathematical models, Analytical techniques, *Aquifer characteristics, *Aquifer testing, Unconfined aquifer, *New York, Long Island, Radial-flow model, Stallman curves, *Drawdown.

Drawdown and recovery data from three 2-day aquifer tests (OF) the unconfined (water-table) aquifer in southern Nassau County, N.Y., during the fall of 1979, were analyzed. Several simple analytical solutions, a typecurve-matching procedure, and a Galerkin finite-element radial-flow model were used to determine hydraulic conductivity, ratio of horizontal to vertical hydraulic conductivity, and specific yield. Results of the curve-matching procedure covered a broad range of values that could be narrowed through consideration of data from other sources such as published reports, drillers' logs, or values determined by analytical solutions. Analysis by the radial-flow model was preferred because it allows for vertical variability in aquifer properties and solves the system for all observation points simultaneously, whereas the other techniques treat the aquifer as homogeneous and must treat each observation well separately. All methods produced fairly consistent results. The ranges of aquifer values at the three sites were: horizontal hydraulic conductivity, 140 to 380 feet per day; transmissivity 11,200 to 17,100 feet squared per day; ratio of horizontal to vertical hydraulic conductivity 2.4:1 to 7:1, and specific yield, 0.13 to 0.23. (USGS)
W84-00658

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2B: SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00660

HYDROGEOLOGY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS - NORTHERN YORK AND SOUTHERN CUMBERLAND COUNTIES, MAINE,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00667

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00668

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00669

SUPPLEMENT TO THE NEW MEXICO THREE-DIMENSIONAL MODEL (SUPPLEMENT TO OPEN-FILE REPORT 80-421),
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00678

EFFECTS OF SANITARY SEWERS ON GROUND-WATER LEVELS AND STREAMS, NASSAU AND SUFFOLK COUNTIES, NEW YORK--PART I: GEOHYDROLOGY, MODELING STRATEGY, AND REGIONAL EVALUATION,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-00679

2G. Water In Soils

WATER-REPELLENT SUBSTANCES AND AGGREGATE STABILITY IN HYDROPHOBIC SOIL,
G. Giovannini, S. Lucchesi, and S. Cervelli.
Soil Science, Vol 135, No 2, p 110-113, February, 1983. 4 Tab, 22 Ref.

Descriptors: *Water repellent soils, *Soil aggregates, *Soil erosion, Erosion, Chelation, Organic matter, Soil physical properties, Soil organic matter, Soil cement.

Solvent extraction of five naturally water repellent clay loam soils from Corleone, Sicily, reduced the water repellency of the samples. Water drop penetration times decreased from 484-540 sec to 124-155 sec with benzene extraction and 130-152 sec with benzene/acetylacetone. The extracts applied to 30 mesh and reduced the water stability index from 53-57 to 44-48 with benzene and to 33-38 with benzene/acetylacetone. Iron and aluminum complexed with organic matter were removed by benzene/acetylacetone, but not by benzene alone. Although aggregation reduces soil erodibility in most soils, in water repellent soils the hydrophobic coating restricts infiltration and causes intensive surface runoff and increased erosion. (Cassar-FRC)
W84-00401

STOCHASTIC ANALYSIS OF ONE-DIMENSIONAL STEADY STATE UNSATURATED FLOW: A COMPARISON OF MONTE CARLO AND PERTURBATION METHODS,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering.
J. Andersson, and A. M. Shapiro.
Water Resources Research, Vol 19, No 1, p 121-133, February, 1983. 18 Fig, 1 Tab, 14 Ref.

Descriptors: *Unsaturated flow, *Soil water, *Infiltration, Stochastic hydrology, Subsurface flow, Hydraulic conductivity, Monte Carlo method, Drainage, Model studies, Spatial variation, Perturbation techniques.

The stochastic nature of moisture content in a soil profile under steady state, unsaturated infiltration is examined, where the saturated hydraulic conductivity is taken as a stationary stochastic process. Two different techniques are employed in determining the stochastic output. These are Monte Carlo simulations and an analytic derivation from a first-order perturbation solution. In comparing the two techniques, the liability of the perturbation expressions is investigated if the Monte Carlo results are assumed to exactly represent the stochastic nature of the moisture content. In four test examples a relatively good comparison is obtained between the results of the two techniques. The analytic nature of the perturbation solution then readily provides information concerning the general stochastic properties of the moisture content, and this way, additional Monte Carlo runs are avoided. From this analysis it is shown that the moisture content is a stationary stochastic process at distances far from boundary regions. The distance from the boundary to regions of stationarity is dependent upon soil properties and the boundary conditions imposed. (Author's abstract)
W84-00407

THE CROSS-COUPLING TRANSPORT COEFFICIENT FOR THE STEADY FLOW OF HEAT IN SOIL UNDER A GRADIENT OF WATER CONTENT,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. Y. Chu, G. Sposito, and W. A. Jury.
Soil Science Society of America Journal, Vol 47, No 1, p 21-25, 1983. 13 Ref.

Descriptors: *Heat flow, *Soil physics, *Thermodynamics, Soil water, Jury-Miller equation.

A theoretical discussion based on the thermodynamics of irreversible processes (TIP) is given concerning the flux equations for the coupled, steady flows of water and heat in a soil as formulated by Jury and Miller (1974). It is shown that a unique definition of the heat flux vector in a coupled flow process is not possible within the context of TIP alone, although differences between heat flux vectors can be defined uniquely. It is shown also that any set of coupled expressions for simultaneous, steady water and heat flow in soil that is compatible with TIP can be used to derive the Jury-Miller formulation of the flux equations by means of linear transformations. Moreover, the cross-coupling coefficient that links the heat flux to the gradient of water content vanishes identically in this formulation. However, a particular definition of the heat flux is implied by the Jury-Miller equations, and its relationship to the measured heat flux cannot be established solely by the methods of TIP. An examination of the data on heat and water flow reported by Jury and Miller indicated that the experimental sensitivity was not sufficient to discriminate among several alternative definitions of the heat flux that can be developed within TIP. This result serves to emphasize the point that the identification of the heat flux actually measured in a coupled flow experiment must be on the basis of either a theoretical model of the coupled flow processes or an application of the general equation of total energy balance. (Author's abstract)
W84-00425

2H. Lakes

MODEL OF LIGHT PENETRATION IN A TURBID LAKE,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. G. Stefan, and J. J. Cardoni.
Water Resources Research, Vol 19, No 1, p 109-120, February, 1983. 21 Fig, 4 Tab, 30 Ref.

Descriptors: *Suspended solids, *Light penetration, Photosynthesis, Oxbow lakes, Turbidity, Lake Chicot, Arkansas, Lakes, Model studies, Radiation, Organic matter.

The attenuation of light with depth of water and the effect of suspended solids (clay, phytoplankton, and organic detritus) on the attenuation were described by equations for Lake Chicot, a 20 sq km highly turbid oxbow lake in Arkansas. Chlorophyll a affected total attentuation coefficients only at high concentrations; inorganic suspended solids dominated light attenuation in this lake. Since ligh attenuation is a function of wavelength, thre bands were distinguished: photosynthetically active radiation, visible light, and total radiation Light as seen by flat plate sensors and spherically integrated light as experienced by an algal ce were distinguished. A relationship was develope between incident total radiation measured abov the water to underwater photosynthetically activ radiation. (Cassar-FRC)
W84-00400

SANDY-GRAVELLY MASS-FLOW DEPOSIT IN AN ICE-MARGINAL LAKE (SAALIAN LEUVENUMSCHE BEEK VALLEY, VELUWE THE NETHERLANDS), WITH EMPHASIS O PLUG-FLOW DEPOSITS,
Amsterdam Univ. (Netherlands). Geological Ins
For primary bibliographic entry see Field 2J.
W84-00416

NUMBER, BIOMASS, AND PRODUCTION O BACTERIOPLANKTON OF THE KUIBYSHE RESERVOIR IN 1979,
Akademiya Nauk SSSR, Borok. Inst. Biolog Vnutrennykh Vod.
A. V. Ivatin.
Water Resources (English Translation), Vol 8, N 6, p 665-670, November-December, 1981. 2 Fig, Tab, 9 Ref. Translated from Vodnye Resursy, N 6, p 159-164, November-December, 1981.

Descriptors: *Reservoirs, *Bacteria, *Populatio dynamics, Bacterioplankton, Kuibyshev reservoi Seasonal variation, *USSR.

In 1979 studies were made on the Kuibyshev rese voir to trace the changes in the number and bio mass of bacterioplankton in time and space, t compare the time of doubling of the number an biomass of bacteria, and to determine the produc tion of bacterioplankton. The number of bacteric plankton in various stretches of the reservoi during the growing season varied from 0.39 to 4.3 million cells/ml and was highest at the time of th spring flood in May. A decrease of the number o microorganisms with a simultaneous decrease o water turbidity was observed from the uppe reaches of the reservoir toward the dam. Signifi cant differences in the number of bacterioplankto were not found in the surface and bottom wate layers. The distribution of the bacterioplankto between the surface and bottom layers and it change over the longitudinal profile of the reser voir in general features is similar to the corre sponding changes in the number of bacterioplank ton. The most intense multiplication and produc tion of biomass occurred in summer, indicating high activity of the microflora of the reservoi (Baker-FRC)
W84-00518

IMPACT OF CHANGING ACIDITY ON THE TROPHIC DYNAMICS OF PINE BARRENS PLANKTON COMMUNITIES,
Rutgers - The State Univ., Camden, NJ. Dept. o Biology.
For primary bibliographic entry see Field 5C.
W84-00684

2J. Erosion and Sedimentation

WATER-REPELLENT SUBSTANCES AND AG GREGATE STABILITY IN HYDROPHOBIC SOIL,
For primary bibliographic entry see Field 2G
W84-00401

SANDY-GRAVELLY MASS-FLOW DEPOSITS IN AN ICE-MARGINAL LAKE (SAALIAN LEUVENUMSCHE BEEK VALLEY, VELUWE THE NETHERLANDS), WITH EMPHASIS ON PLUG-FLOW DEPOSITS,
Amsterdam Univ. (Netherlands). Geological Inst
G. Postma, T. B. Roep, and G. H. J. Ruegg.
Sedimentary Geology, Vol 34, No 1, p 59-82, 1983 12 Fig, 39 Ref.

criptors: *Lake sediments, *Sediments trans-
, *Glacial lakes, Paleolimnology, Deposition,
vel, Sand, Plug flow, Sedimentology, Leuven-
che Beek Valley, The Netherlands.

lies of deposits in three sand-gravel pits in the
venumsche Beek Valley, the Netherlands, re-
ed the existence of an ice-marginal lake. Sedi-
t sequences showed that ice-pushed ridges on
er side of the ancient lake had slumped downs-
. The sand pits revealed U-shaped channel
is with a maximum depth and width of 10 x 25
They are filled with sand, gravels, and giant
clasts. Just below the base of the channel
is sediments are distorted and folded. This
gests that rigid sediment plugs sheared downs-
, generating a finer-grained shear zone around
plug, scouring a slide scar. Evidence of flow
ations are found in the sediment sequences
lying the plugged U-shaped channel forms.
ning flow conditions are indicated by upwards
ning of the sequence and finer grain size.
sar-FRC)
-00416

**DELING EROSION ON LONG STEEP
OPES WITH EMPHASIS ON THE RILLING
OCESS,**
tucky Univ., Lexington. Dept. of Agricultural
ineering.
C. Hirschi, B. J. Barfield, and I. D. Moore.
ilable from the National Technical Information
rice, Springfield, VA 22161 as PB84-125129,
e codes: A10 in paper copy, A01 in microfiche.
er Resources Research Institute Research
ort No 148, September 1983. 222 p, 38 Fig, 14
135 Ref, 5 Append. OWRT B-072-KY(1), 14-
001-0224.

criptors: *Erosion, *Soil erosion, Erosion rates,
e stability, *Model studies, *Slopes, Slope deg-
tion, *Rill erosion, Rills, Rainfall impact, Infil-
on.

odel of soil erosion, known as KYERMO, is
ented which emphasizes those processes which
important on steep slopes. Particular emphasis
aced on modeling rill development and geome-
since this is the least understood process in
ion mechanics. The model requires an input rill
ern. Rainfall inputs to the model require the
of breakpoint rainfall and kinetic energy. Sur-
storage is calculated on random roughness
of Linden (1979). Infiltration is modeled by
of the two layer Green-Ampt-Mein-Larson
el as proposed by Moore and Eigel (1981).
off is related to rainfall excess and surface
ge by the exponential relationships of Tholin
Kiefer (1960). Erosion is modeled separately as
and interrill erosion. Interrill erosion is mod-
by evaluating raindrop splash and interrill
sport capacity. Raindrop splash is predicted by
g the Bubenzer and Jones (1971) equation
ch requires kinetic energy, rainfall intensity,
percent clay. Interrill transport capacity is
eled by either the Yalin (1963) or Yang (1973)
tion depending on user preference. The rate of
very of soil to a rill is a minimum of either the
sport rate or splash rate. Rill detachment ca-
ty is calculated using the shear excess equation
oster (1982). Transport capacity is calculated
either the Yalin (1963) or Yang (1973) de-
ding on user preference. The distribution of
chment around the rill boundry is calculated as
nction of the shear distribution. Shear is distrib-
by using a modification of the area method of
dgren and Johnson (1964).
-00445

**RLD-WIDE DELIVERY OF RIVER SEDI-
NT TO THE OCEANS,**
ods Hole Oceanographic Institution, MA.
. Milliman, and R. H. Meade.
nal of Geology, Vol 91, No 1, p 1-21, 1983. 4
4 Tab, 68 Ref.

criptors: Rivers, *Oceans, *Sediment transport,
ment load.

mates based on both new and old data indicate
rivers with large sediment loads contribute about 7 x 10 to the 9th power tons of suspended sediment to the ocean each year. The data on which these estimates are based have a number of serious potential errors which need to be considered in either local or world-wide budgets. The most important factor is the widely variable quality of the data as a result of differences in measurement techniques, lengths of observation, and sampling procedures. The sediment loads of the large rivers in North America have been measured for as many as 50 years. Rivers draining the eastern part of the continent have small sediment loads. Rivers discharging into the Gulf of Mexico transport the greatest amount of sediment in the conterminous US. Sediment loads in rivers in the western part of the US are generally considered to be large, but again dams and reservoirs have decreased them considerably. Alaskan rivers that drain glaciers have much greater sediment yields. The largest river, the Amazon, still has a sediment load which is relatively unknown. The rivers that drain Europe are small and carry little sediment. Only the Rhone, Po, and Danube Rivers appear to have annual sediment discharges in excess of 10 x 10 to the 6th power tons. The Eurasian Arctic is drained by three large rivers, the Ob, Yenisei and Lena, all having drainage areas of about 2,500,000 sq km and water discharges of 385 to 560 cubic km/yr. However, the areas have been largely stripped of sediment by Pleistocene glaciers. River drainage in China and in the Asian continent exclusive of China are also considered. About 70% of the total river sediment delivered to the oceans is derived from southern Asia and the larger islands in the Pacific and Indian Oceans. (Baker-FRC)
W84-00575

PETROLOGY, CHEMISTRY, AND TEXTURE OF MODERN RIVER SANDS, AMAZON RIVER SYSTEM,
Amazonas Univ., Manaus (Brazil).
E. Franzinelli, and P. E. Potter.
Journal of Geology, Vol 91, No 1, p 23-39, 1983. 8 Fig, 6 Tab, 41 Ref.

Descriptors: *Sedimentation, *Sediment transport, Rivers, *Sand, Minerals, Quartz, *Amazon River, Subarctic regions, Temperate zones, Brazil, Peru, Ecuador, Colombia.

The thin section petrology and texture of the light minerals of 95 modern sands collected from the Amazon river system in Brazil and adjacent parts of Columbia, Ecuador, and Peru were examined. The sands derived from the Andes are lithic arenites, whereas sands derived from Precambrian terrains are much richer in quartz. Sands in rivers draining Tertiary molasse are also rich in quartz. Sand becomes more mature downstream along the main stem of the Amazon-Soliomes-Maranon, so that a sample analyzed at the mouth does not accurately reflect composition of the headwater. Enhanced maturity downstream results from dilution by quartz-rich tributaries and quartz-rich Tertiary outcrops, possible differential elimination of rock fragments, and even possible weathering on the modern flood plain of the Amazon. It is suggested that large subarctic and temperate rivers do not have a marked downstream increase in mineralogic maturity. River sands of Precambrian watersheds are coarser than those derived directly from either the Andes or from those derived from Tertiary molasse for two apparent reasons. First, Precambrian granites have coarser quartz than the reworked quartz of a major geosyncline, and second, tropical weathering eliminates quartzofeldspathic rock fragments much more rapidly than quartz. (Baker-FRC)
W84-00576

2K. Chemical Processes

IRON MINERALIZATION OF PERITIDAL CARBONATE SEDIMENTS BY CONTINENTAL GROUNDWATERS, FISHERMAN BAY, SOUTH AUSTRALIA,
Baas Becking Geobiological Lab., Canberra (Australia).
J. Ferguson, R. V. Burne, and L. A. Chambers.
Sedimentary Geology, Vol 34, No 1, p 41-57, 1983. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Iron, *Geochemistry, *Aquifer properties, Manganese, Fisherman Bay, Australia, Chemical precipitation, Sediments, Groundwater, Saline water, Geology, Bays.

Iron and manganese are precipitating from saline groundwaters flowing towards the hypersaline waters of Fisherman Bay, South Australia, from red bed aquifer systems in the coastal plain. In one area a lens-shaped body 500 sq m in area and 20 cm thick has formed. This contains ferric oxide at concentrations of 30%-70% by weight. Saline groundwaters associated with the iron mineralization contain up to 67.3 ppm Fe with pH of about 6. These high Fe concentrations are probably caused by: (1) adequate and readily soluble Fe in the aquifer, (2) biological activity which lowers the electrical conductivity without limiting Fe solubility by production of hydroxide or sulfide ions, and (3) absence of buffering minerals. Fe and Mn are separated in the bay sediments because Fe separates first, followed by Mn on the seaward fringe, where carbonates are found. The groundwaters in the aquifer system are potential ore-forming fluids. The present bay deposit has formed within 2000 to 6000 years. (Cassar-FRC)
W84-00418

THE COMPOSITION AND DEPOSITION OF ORGANIC CARBON IN PRECIPITATION,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
G. E. Likens, E. S. Edgerton, and J. N. Galloway.
Tellus, Vol 35B, No 1, p 16-24, 1983. 1 Fig, 3 Tab, 34 Ref.

Descriptors: *Precipitation, *Organic carbon, Deposition, Acid rain, Particulate matter, Organic acids, Hubbard Brook, New Hampshire, Ithaca, New York, Forest watersheds, Chemical composition, Fate of pollutants, Water pollution sources.

Wet-only precipitation collected at Hubbard Brook (HB), New Hampshire, a heavily forested site, and Ithaca, New York, from June 1976 to May 1977 was analyzed for several types of organic carbon. Annual volume weighted mean concentrations (mg per liter) were: total organic carbon, 2.37 at Ithaca and 1.28 at HB; dissolved organic carbon, 1.88 at Ithaca and 1.09 at HB; and particulate organic carbon, 0.49 at Ithaca and 0.20 at Hubbard Brook. Deposition of total organic carbon was 24,230 g per ha at Ithaca and 14,031 g per ha at HB. Organic material concentrations and rainfall levels were highest in June-September. Particulate plus dissolved macromolecular (>1000 MW) organic matter accounted for 51% and 63% of total organic carbon at HB and Ithaca, respectively. The remainder of the carbon, the fraction containing compounds of <1000 MW, consisted largely of carboxylic acids, aldehydes, carbohydrates, tannin/lignin, primary amines, and phenols. Sources of the organic materials were airborne soil dust and plant material. The organic acids present in the rain at HB contributed only 2% of the total acidity. (Cassar-FRC)
W84-00424

ACID PRECIPITATION IN SOUTHEASTERN WYOMING,
Wyoming Univ., Laramie. Water Resources Research Inst.
J. Ahern, and C. Baird.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132521, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, September 1983. 96 p, 3 Fig, 17 Tab, 33 Ref, 6 Append. OWRT A-032-WYO(1), 14-34-0001-1154.

Descriptors: *Acid rain, Snow, Snowpack, Chemical properties, Hydrogen ion concentration, Chemical analysis, Laramie, *Wyoming, Snowy range.

Snowfall, snowpack, and rainfall samples were collected in Laramie, Wyoming and in the Snowy Range west of Laramie from March to June 1981 to determine the occurrence and sources of acid precipitation in southeast Wyoming. Electrodes measured different pH values in the samples; how-

ever, fast-response electrodes yielded higher and apparently more accurate pH measurements. The pH values in the Laramie precipitation and snowpack were typically greater than 5.0, but all the Snowy Range snowpack pH values were less than 5.0. The lower pH values in the Snowy Range snowpack were caused by higher concentrations of the acid-forming nitrate and lower concentrations of the neutralizing calcium. Two organic species, formate and acetate, were detected in the Laramie samples, but had no significant influence on the acidity of the samples.
W84-00639

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING--A WATER SUPPLY ALTERNATIVE FOR VIRGINIA BEACH,
Pirnie (Malcolm), Inc., Newport News, VA.
M. P. Robinson, Jr., G. P. Westerhoff, and T. M. Leahy, III.
Journal of the American Water Works Association, Vol 75, No 3, p 109-117, March, 1983. 8 Fig, 5 Tab, 15 Ref.

Descriptors: *Water supply, *Brackish water, *Wastewater renovation, Desalination, Water treatment, Virginia Beach, Virginia, Membrane processes, Costs, Reverse osmosis, Water demand, Social aspects, Seawater, Demineralization, Energy, Regulations.

Desalting of brackish groundwater was chosen as a short-term practical alternative in a cost evaluation of 24 water supply options for Virginia Beach, Virginia. The city currently receives its water from Norfolk, which may not be able to satisfy water demands by the year 2000. The alternatives were grouped into 7 general headings: expanding regional surface water impoundments, expanding the Norfolk system, developing impoundments already existing, developing shallow groundwater aquifers, developing regional groundwater supplies, reclaiming wastewater, and desalting brackish groundwater or seawater. Costs per 1000 gal for several treatment techniques were: brackish water, $1.80-2.00; wastewater reclamation, $3.10-4.60; and seawater, $4.30-6.00. Improvements in reverse osmosis and other membrane processes are expected to reduce present costs by as much as 50%. However, energy costs are a highly significant part of cost evaluation. Wastewater reclamation and seawater desalting have the greatest promise for a long-term solution to Virginia Beach's water supply problems. (Cassar-FRC)
W84-00387

WIPED-FILM ROTATING-DISK EVAPORATOR FOR WATER REUSE,
California Univ., Berkeley. Water Thermal and Chemical Technology Center.
B. W. Tleimat, and T. Vermeulen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120880, Price codes: A05 in paper copy, A01 in microfiche. Technical Report RU-S2/15, U.S. Dept. of the Interior/OWRT, Washington, D.C., November 1982. 62 p, 20 Fig, 4 Tab, 14 Ref, 3 Append. OWRT C-00165-R(No 0537)(1), 14-34-0001-0537.

Descriptors: *Rotating-disk evaporator, *Wiped film. Distillation, Heat transfer, Energy consumption, Heat-transfer coefficient prediction and measurement, Modular design, Water reuse.

Two different disk designs for the wiped-film rotating-disk evaporator were built in order to compare their heat-transfer performance. In one design, 1 mm thick brass disks were spun-formed on a spherical mold; in the other, 0.8 mm-thick brass disks were made flat and the outside flange was formed by spinning. The heat-transfer coefficient was not influenced by the disk shape, but was affected unfavorably by surface roughness. Its analytical prediction agreed well with experimental results, showing overall heat-transfer coefficients as high as 28 kW/m super 2C (8000 Btu/hr ft super 2F) and 23 kW/m super 2C (6500 Btu/hr ft super 2F) for copper and brass disks respectively. A conceptual design of a five-effect vapor-compression system to desalt 10 m super 3/day (2500 gallons/day) from seawater was made and costed. Based on data obtained, with an overall temperature difference of 1.5F across the heat-transfer surface, the energy consumption by the compressor (50% isentropic efficiency) was calculated to be 6.2 kWh/m super 3 (23.6 kWh/1000gal) of product.
W84-00438

DEVELOPMENT OF A LARGE SPIRAL MODULE FOR SEAWATER DESALINATION BY REVERSE OSMOSIS,
UOP, Inc., San Diego, CA. Fluid Systems Div.
G. E. Foreman, and J. E. Beckman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125111, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, September 1983. 53 p, 6 Fig, 3 Tab, 3 Append. OWRT C-80344-S(No 8573)(1), 14-34-0001-8573.

Descriptors: *Desalination apparatus, *Reverse osmosis, *Membrane filters, Reverse osmosis modules.

Work under OWRT Contract No. 14-34-0001-8573 was directed toward the development and testing of 12-inch diameter seawater reverse osmosis modules. The major development was the pressure tube assembly which resulted in the selection of an epoxy/fiberglass (FRP) pressure tube having an initial burst pressure in excess of 7200 psi. Safety as well as functionality was of prime importance. Twelve inch diameter spiral-wound elements containing 700 ft super 2 of active membrane were fabricated and ultimately tested at the Government Test Facility located at Wrightsville Beach, North Carolina. The modules provided performed well mechanically during the testing period verifying the tube design developed during the Contract. The elements, although sound mechanically, did not produce the quantity and quality of water originally anticipated. Chlorine in the feedwater caused some failures. It is suspected also that the product water channel material utilized may have contributed to lower than expected permeate flow.
W84-00444

OPTIMAL SELECTION OF MAJOR EQUIPMENT IN DUAL PURPOSE PLANTS,
Italconsult, Rome (Italy).
E. Gabbrielli.
Desalination, Vol 36/1, Jan 1981, p 1-23, 5 Fig, 4 Tab, 15 Ref.

Descriptors: *Desalination, Desalination plants, Dual purpose plants, *Economic evaluation, Combustion turbines, *Multistage flash distillation, Optimization.

Simulation of different operational conditions with the aid of a computer program is one of the best ways of assisting decision-makers in the selection of the most economic mix of equipment for a dual purpose plant. An economic comparison is provided of plants consisting of MSF desalinators and combustion gas or back pressure steam turbines coupled to low capacity electric power generators. The comparison is performed on the basis of the data made available by the OPTDIS computer program and the results are given in terms of yearly cost of production as the sum of capital, manpower, maintenance, fuel and chemical costs.
W84-00449

DEVELOPMENT OF A NEW ASYMMETRIC ALLOY MEMBRANE FOR WATER DESALINATION,
Toulouse-3 Univ. (France). Lab. de Chimie-Physique et Electrochimie.
P. Aptel.
Desalination, Vol 36/1, Jan 1981, p 25-37, 8 Fig, 3 Tab, 9 Ref.

Descriptors: *Desalination, Desalination pla
*Membranes, Polymers, Asymmetric membra
Poly(4-vinylpyridine), *Cellulose acetate.

The preparation of a novel asymmetric membr
case from a poly (4-vinylpyridine) and cellul
acetate homogeneous mixture is discussed. T
two polymers were miscible in concentrated so
tions. Asymmetric membranes were cast from
sexted dope mixture containing: chlorofo
methanol, acetone and formamide. The as-cast
lution, when coagulated in water at ambient te
perature, yields a highly plasticized asymmet
matrix which, upon slow diffusion of the chlo
form into the water, solidifies into a glassy st
The membranes following this stage, do not
quire annealing and yield high fluxes and salt rej
tion when tested in reverse osmosis. The asymm
ric morphology was confirmed by scanning el
tron microscopy studies which revealed a de
skin resting upon a highly porous, open-cell
foam-like structure. This structure retains its o
ginal wet dimensions upon drying. Brief attem
to quaternize the matrix are also reported.
W84-00450

**ASYMMETRIC REVERSE OSMOSIS AND U
TRAFILTRATION MEMBRANES PREPARE
FROM SULFONATED POLYSULFONE,**
Centre National de la Recherche Scientifiq
Paris (France). Lab. de Physicochimie Structur
et Macromoleculaire.
C. Freidrich, A. Driancourt, C. Noel, and L. Monnerie.
Desalination, Vol 36/1, January 1981, p 39-62, Fig, 5 Tab, 15 Ref.

Descriptors: *Desalination, Desalination plan
Membranes, *Reverse osmosis, Ultrafiltratio
Asymmetric, *Polysulfone membranes, Solubili

The concept of solubility parameter, developed
Hansen, was applied to the determination of so
bility diagram of polysulfone and sulfonated pol
sulfone. Data showing the effect of various para
eters such as thermodynamic quality of the solve
casting solution composition and viscosity, solve
evaporation period and precipitation bath compo
tion, on membrane structure and performan
were presented. By adjusting these parameters
wide variety of sulfonated polysulfone membran
useful for both ultrafiltration and reverse osmo
applications could be obtained.
W84-00451

**ASYMMETRIC POLIVINYLIDENFLUORID
(PVDF) RADIATION GRAFTED MEMBRANE
PREPARATION AND PERFORMANCE IN R
VERSE OSMOSIS APPLICATION,**
Genoa Univ. (Italy). Inst. of Industrial Chemistr
F. Vigo, G. Capannelli, C. Uliana, and S. Munari.
Desalination, Vol 36/1, Jan. 1981, p 63-73, 8 Fi
18 Ref.

Descriptors: *Desalination, Desalination plan
*Reverse osmosis, *Membranes, Asymmetri
PVDF films, Gels.

A type of reverse osmosis membrane was synth
sized. Membranes were prepared starting fro
asymmetric PVDF films, obtained by the castir
and gelation technique and modified by radioch
mical grafting and sulphonation. These membran
were tested in an RO laboratory plant and the
performances were determined as a function
preparative parameters. The influences of evapor
tion time and temperature grafting and solven
were investigated. These membranes exhibit pe
meabilities as high as 2000 l/m super 2 d an
sodium chloride rejections up to 70%.
W84-00452

**PARAMETRIC STUDY OF COST FACTORS I
RO DESALINATION (GKSS PLATE SYSTEM**
GKSS - Forschungszentrum Geesthacht G.m.b.H
Geesthacht-Tesperhude (Germany, F.R.)
J. Kaschemekat, and K. W. Boddeker.
Desalination, Vol 36/1, January 1981, p 75-85, Fig, 5 Ref.

scriptors: *Desalination, Desalination plants, everse osmosis, Membranes, GKSS plate tem, *Computers.

sults of a computer-aided analysis of the individ- effects of some typical system-related and oper- ng parameters on product water costs in the RO alination of brackish water and seawater by ans of the GKSS plate system are presented. 34-00453

VESTIGATION OF PURIFICATION MECH- ISM IN A COLUMN CRYSTALLISER OP- ATING UNDER TOTAL REFLUX AND NTINUOUS CONDITIONS,
y Univ., London (England).
T. Arulampalam, C. Bates, L. F. Khaw, and L. Grath.
salination, Vol 36/1, January 1981, p 87-97, 8 , 2 Tab, 7 Ref.

scriptors: *Desalination, Desalination plants, ntinuous column, *Crystallizers, Indirect refrig- tion, *Freezing, Water purification.

boratory work was continued on the design and eration of continuous column crystallizers. In ler to elucidate the dominant factor in the purifi- ion process, an extractive washing model has en utilized to calculate values of the diffusion l mass transfer groups. Total reflux and continu- feed conditions were used. The size and shape re investigated of the ice crystals formed in the ezing section of the column. Modification of the ew conveyer was necessary to facilitate crystal noval.
34-00454

IE EFFECT OF PRESSURE ON THE BULK OLYMER MICROSTRUCTURE IN CELLU- OSE ACETATE REVERSE OSMOSIS MEM- ANES,
greb Univ. (Yugoslavia). Faculty of Pharmacy l Biochemistry.
Arneri.
salination, Vol 36/1, January 1981, p 99-104, 3 , 16 Ref.

scriptors: *Desalination, Desalination plants, embranes, *Reverse osmosis, Polymers, Micros- cture pressure, Differential scanning calori- try.

e pressure effect on the bulk polymer micros- cture was investigated using Differential Scan- g Calorimetry (DSC). The samples of both nse' CA-398-3 membranes and Kesting dry mmetric CA-398-3 membranes investigated. e pressure treatment is also a kind of an 'anneal- ' process that orders the polymer microstruc- e. The effect takes place both in the case of the ginally more ordered (from a DSC point of w) polymer microstructure of 'dense' CA mem- nes and the originally less ordered (almost com- tely amorphous) polymer microstructure of the asymmetric CA membranes investigated. DSC rves on the thermoanalytical diagrams of the ssure treated 'dense' CA membranes show inly a shift of the endothermic peak (melting ocessu) to higher temperatures, and DSC curves the pressure treated Kesting dry asymmetric mbrane samples show both a shift of the endoth- nic peak to higher temperatures and quite an argement of the area under the peak. Pressure ion orders (densifies) the bulk polymer micros- cture of both the skin and porous layer of an mmetric CA reverse osmosis membrane.
34-00455

EXPERIMENTAL STUDY OF SPRAY ASH EVAPORATION,
ushu Univ., Fukuoka (Japan). Research Inst. of dustrial Science.
Miyatake, T. Tomimura, Y. Ide, and T. Fujii.
salination, Vol 36, No 2, February 1981, p 113- , 11 Figs, 1 Tab, 16 Refs.

scriptors: *Desalination, *Distillation, Jets, lash evaporation, Sprays.

Spray flash evaporation was studied occurring in a superheated water jet injected through a circular tube nozzle into a low-pressure vapor zone. The effects of superheat, flow rate and nozzle diameter on spray flashing were pursued at 66C jet inlet temperature. From the experimental results, an empirical equation suitable for predicting the variation of liquid temperature with residence time was deducted.
W84-00456

PERFORMANCE OF A POLYPHOSPHATE-BASED SCALE CONTROL ADDITIVE IN AN MSF PLANT OF KUWAIT,
Kuwait Water Resources Development Centre, Shamiya.
F. H. Butt, and A. H. Bou-Hassan.
Desalination, Vol 36, No 2, February 1981, p 129-136, 4 Figs, 1 Tab, 4 Refs.

Descriptors: *Desalination, Desalination plants, *Distillation, Multistage flash, Kuwait, Polyphosphate-based additive, *Scaling.

Test of a polyphosphate-based scale control additive, carried out for a period of 8 months during 1978, showed that it was only moderately effective as a scale inhibitor. The gained out-put ratio, which was close to the design value of 8.0 at the start-up, declined by 30% during the test period while the distillate output fell off by about 25% in the same period. Even though the brine heater steam temperature was progressively increased from 93.3C to 118.3C, a steady decline was observed in the heater inlet and outlet temperatures which decreased from 81.7 to 73.3C and 86.7 to 79.4C respectively. It took only 40 days of operation for the heater fouling factor to exceed the design value. The fouling factor registered a five to seven-fold increase in 8 months.
W84-00457

A COMPARISON OF THE RELATIVE ECONOMICS OF SEA WATER DESALINATION BY VAPOUR COMPRESSION AND REVERSE OSMOSIS FOR SMALL TO MEDIUM CAPACITY PLANTS,
Israel Desalination Engineering Ltd., Tel-Aviv.
R. Matz, and U. Fisher.
Desalination, Vol 36, No 2, February 1981, p 137-151, 4 Figs, 8 Tab, 11 Refs.

Descriptors: *Desalination, Desalination plants, Seawater, *Vapor compression, *Reverse osmosis.

Lowest energy consumption is not necessarily the determining criterion for lowest cost sea water desalination. It is shown that at present-day market prices for plants, electrical energy, and fuel oil, Vapour Compression plants with horizontal aluminium tubes - the 'Ambient Temperature' Vapour Compression (ATVC) system - compares economically with Sea Water Reverse Osmosis (SWRO) even at the lowest net energy consumption achieved by the latter process by the use of high efficiency energy recovery turbines. This economic parity is shown to apply for plants of up to 4000 m super 3/day (1 mgd), and is shown to be maintained for future foreseeable developments resulting in reduced energy consumptions and more efficient plants. More areas for potential improvements are available for ATVC, than for SWRO, which may result in more favorable economics for the former process in the future.
W84-00458

REVERSE OSMOSIS IN THE DESALINATION OF BRACKISH WATER AND SEA WATER,
Hager and Elsasser G.m.b.H., Stuttgart (Germany, F.R.).
H. Ludwig.
Desalination, Vol 36, No 2, February 1981, p 153-178, 20 Figs, 5 Tab, 20 Refs.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Seawater, Brackish water, *Polyamide hollow fiber modules.

To make RO an economical process, plant and operating costs have been reduced by developing compact modules, led by polyamide hollow fiber modules which recover energy from the reject when desalinating highly saline brackish water and seawater. Such plants only start to pay their way at product rates of around 400 cu m /d plus. Energy costs for desalination systems with lower capacities can also be reduced considerably by operating the RO plants at conversion rates of more than 30%. To what extent the required higher conversion rates can be obtained for a particular application depends on concentration of scale-forming content matter (calcium sulphate, strontium sulphate, barium sulphate and calcium carbonate), salt content of the raw water, concentration of fouling substances such as iron, manganese, anorganic and organic matter, risk of biological growth due to algae, shells and bacteria. The scope and type of conditioning and pretreatment are based on these factors.
W84-00459

APPLICATION OF REVERSE OSMOSIS TO AUTOMOTIVE ELECTROCOAT PAINT WASTEWATER RECYCLING,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
J. E. Anderson, W. S. Springer, and G. G. Strosberg.
Desalination, Vol 36, No 2, February 1981, p 179-188, 2 Figs, 4 Tab, 11 Refs.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Wastewater treatment, *Automative electrocoat paint, Water reuse.

Field and bench-scale RO experiments on wastewater derived from automotive electrocoat paint operations are reported. Field experiments were performed continuously over a 6 month interval using a RO unit equipped with cellulose acetate membranes. An operating pressure of 3100 kPa (450 psi) and a temperature of 24-27C was maintained. These RO experiments were unusual for two reasons. First, certain solutes in the feedwater were allowed to permeate through the membrane along with water. This was done to permit solute recycling and reuse. Since these solutes (ethyl, butyl and hexyl glycol ethers) were present in a 3% total concentration in the feedstream, their permeation through the membrane eliminated a flux reduction mechanism. This would arise from the increased upstream osmotic pressure if these solutes were concentrated. The experiments were performed under conditions where colloidal lead was present. This caused limited membrane fouling which was controlled via weekly cleaning with dilute lactic acid. Some supporting bench-scale RO experiments were carried out to probe factors influencing this RO application.
W84-00460

SOLAR DISTILLATION: THE SOLAR-ASSISTED CASE.
Sydney Univ. (Australia). Dept. of Chemical Engineering.
J. P. Gerofi, and G. G. Fenton.
Desalination: Vol 36, No 2, February 1981, p 189-204, 11 Figs, 1 Tab, 10 Refs.

Descriptors: *Desalination, Desalination plants, *Distillation, *Solar stills.

The case is considered where a solar collector system, without storage, is linked to an otherwise stand-alone, fuel-driven desalination plant. The choices involved in selecting the type of solar collector and the design constrains on other components of the thermal source loop are outlined. A rationale is outlined for determining the most economic collector area for such a situation and the proportion of the plant's energy requirement that can be provided by solar energy is discussed. Results for a specific collector desalination plant system, which include the effect of solar collector cost and fuel oil price on the economics, are presented. The decisions and constraints involved in selecting an optimum solar-assisted desalination system for a particular application are outlined.
W84-00461

RAYLEIGH-JEFFREYS STABILITY OF THERMOHALINE STRATIFIED FLUIDS SUBJECT TO VERTICAL FLOWS,
Technion - Israel Inst. of Tech., Haifa. Energy Engineering Center.
M. Bouscher, D. Pnueli, and Y. Zvirin.
Desalination, Vol 36, No 3, March 1981, p 307-333, 1 Fig, 9 Ref.

Descriptors: *Desalination, *Hydrodynamics, Fluid mechanics, Rayleigh-Jeffreys stability, Thermohaline stratified fluids.

The stability of an infinite horizontal layer of fluid with a density stratification due to both temperature and solute gradients, subject to an initial vertical flow field, is studied for different sets of homogeneous boundary conditions. Sufficient conditions for the maintenance of the original stratification, i.e. for stability, are obtained as a relation between the thermal Rayleigh number, and the solute Rayleigh number. A relation is obtained as a sufficient condition for stability for all sets of boundary conditions, and shows that the ratio of the solute to the thermal Rayleigh numbers is less than the negative of the square of the ratio of the solute is the thermal Prandtl numbers. This condition may thus be applied to cases in which the physical boundary conditions are not well defined, e.g. to practical engineering use of solar ponds. In addition, in conjunction with a similar result for initial horizontal flow fields, the result gives a sufficient condition for stability of arbitrary initial flows under all combinations of boundary conditions.
W84-00462

REVERSE OSMOSIS WITH A CELLULOSE ACETATE MEMBRANE IN THE REVERSE ORIENTATION,
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
J. A. M. Smit.
Desalination, Vol 36, No 3, March 1981, p 291-297, 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, *Cellulose acetate membranes.

Salt rejection curves of Cellulose acetate membranes placed with the porous layer towards the influent side and the skin towards the effluent side show typical maxima. Analysis of these maxima yields information on the salt permeabilities of the porous layer and of the skin in a rather direct way.
W84-00463

CONCENTRATION OF CUPRIC AND NICKEL IONS BY COMPLEXATION-ULTRAFILTRATION, SYNERGIC EFFECT OF SUCCINIC ACID,
Centre National de la Recherche Scientifique, Nancy (France). Lab. de Chimie Physique Macromoleculaire.
Q. T. Nguyen, Y. Jyline, and J. Neel.
Desalination, Vol 36, No 3, March 1981, p 277-283, 4 Fig, 6 Ref.

Descriptors: *Desalination, Ultrafiltration, Copper, Nickel, Ions, Succinic acid.

In ultrafiltration, high rejection of small ion species can be achieved by complexing these species with a suitable macroligand. The concentration was studied of cupric and/or nickel ions by ultrafication, through the DDS GR8 membrane, using polyethylenimine as a basic macroligand. The rejections of the metallic ions increased with the pH and the concentration of the polymeric ligand as expected. The addition of succinic acid (a molecular acidic chelating) to the mixtures allowed an improvement of the retentions of these ions at all pHs studied. This indicates that positive synergic effect was obtained by the formation of a mixed complex base-metal-acid.
W84-00464

ADSORPTION OF WATER ON CELLULOSE ACETATE MEMBRANE,
Tohoku Univ., Sendai (Japan). Faculty of Engineering.
Y. Kurokawa.
Desalination, Vol 36, No 3, March 1981, p 285-290, 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, *Cellulose acetate, Casting, Adsorption.

The effect was studied of variables of cellulose acetate membrane procedure on its reverse osmosis properties by adsorption of water vapor. The rate of adsorption of vapor was slower for the membrane prepared at casting condition of longer evaporation period. This variation corresponded to that of water permeability by reverse osmosis performance. It seems from the isotherm data that the overall porosity of membrane is determined during the evaporation step. This provides additional support for membrane properties depending on casting conditions.
W84-00465

EFFECTS OF ACCELERATION ON REVERSE OSMOSIS DESALINATION,
SRI International, Menlo Park, CA.
G. B. Andeen.
Desalination, Vol 36, No 3, March 1981, p 265-275, 5 Fig, 8 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, Reverse osmosis, Hollow fine fibers, Acceleration.

Hollow-fine-fiber reverse osmosis elements were run in a continuous-flow centrifuge at accelerations up to 1000 G. Under acceleration, the elements produced more desalted water and passed less salt, showing a reduction of concentration polarization. Reduced data showed that the mass transfer coefficient of salt from the membrane surface to the bulk of the brine increased with acceleration to the 0.3 power. Acceleration also improved flow distribution by eliminating regions of high-density stagnant brine. Use of a centrifuge will allow utilization of higher transport membranes.
W84-00466

A CRITICAL REVIEW OF FOULING OF REVERSE OSMOSIS MEMBRANES,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
D. E. Potts, R. C. Ahlert, and S. S. Wang.
Desalination, Vol 36, No 3, March 1981, p 235-264, 1 Fig, 94 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, Fouling, *Water reuse, Wastewater treatment.

Reverse osmosis technology is presently undergoing rapid growth in the area of municipal and industrial wastewater reuse. Control of membrane fouling due to organic compounds and particles in wastewater is a major expense in the design and operation of these facilities. A general overview is given of what is known about the fouling process, and technology used to deal with the problem is described. Current research in the field is reviewed, including some recent developments in modeling and fouling control.
W84-00467

RECENT DEVELOPMENTS IN THIN-FILM COMPOSITE REVERSE OSMOSIS MEMBRANE SYSTEMS,
UOP, Inc., San Diego, CA.
R. L. Riley, P. A. Case, A. L. Lloyd, C. E. Milstead, and M. Tagami.
Desalination: Vol 36, No 3, March 1981, p 207-233, 17 Fig, 8 Tab, 20 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, *Water reuse, Thin film composite membranes, Jeddah, Saudi Arabia.

Desalination of seawater by reverse osmosis requires a membrane which approaches theoretical semipermeability and is sufficiently thin to p transport of water at practical operating pr and recovery rates. This objective has achieved by the development of a family film composite membranes based on nitroge taining polymers supported on a fabric-rein porous supporting membrane. The memb packaged in the spiral-wound configuration, it high water permeability, low salt perme thermal stability, resistance to micro-orga wet-dry, and chemical stability. Membranes type are currently employed for the conver seawater to potable water in the world's firs RO plant in Jeddah, Saudi Arabia, trailer-m U.S. Army military units, off-shore drillin forms, marine applications, and handpo emergency units. RO systems, employing th composite membrane elements, are also in ation for the conversion of brackish to p water and a variety of water-reuse applicatio textile finishing, boiler water for electrical u soft drink manufacturing, agricultural wate reclamation of municipal waste water.
W84-00468

PILOT AND FULL-SCALE RESEARCH THE VAPOUR COMPRESSION DESA TION PROCESS,
Rome Univ. (Italy). Inst. of Physical Chem
M. Beccari, A. C. Di Pinto, A. Rozzi, M. San and L. Spinosa.
Desalination, Vol 37, No 3, June 1981, p 257- Fig, 2 Tab, 10 Ref.

Descriptors: *Desalination, Desalination *Vapor compression, Distillation, Vertical bundle, Falling brine film, Heat transfer.

Pilot-scale tests were carried out in order to more about the vapor compression process at erately high temperature (around 100C). O basis of the results obtained, a demonstration (about 240 m super 3/d) was built in order t the actual validity of the process developed. a new type compressor the energy consum was satisfactorily low. By the use of a vertica bundle with falling brine film established by distributors, it was also possible to obtain overall heat transfer coefficients.
W84-00470

COMPARATIVE ANALYSIS OF THE CIENCY OF THERMAL DESALINA PLANTS,
Dalnevostochnyi Politekhnicheskii Inst., Vlad tok (USSR).
V. Slesarenko, and A. Shtim.
Desalination, Vol 37, No 3, June 1981, p 269- Fig, 4 Ref.

Descriptors: *Desalination, Desalination p *Distillation, Economics, Thin film, Seaw Heat transfer.

In the desalination of seawater, energy heat fer losses are greatest. Thin film thermal des tion plants were found to have the best hydro mic, technical, and economic properties.
W84-00471

SCALE DEPOSITION IN A LAMINAR F ING-FILM SYSTEM,
Technion - Israel Inst. of Tech., Haifa. Dep Chemical Engineering.
D. Hasson, and I. Perl.
Desalination, Vol 37, No 3, June 1981, p 279- Fig, 1 Tab, 11 Ref.

Descriptors: *Desalination, *Calcium carbo *Scaling, Transport theories, Laminar-flow, ing-film system.

The mechanism of CaCO sub 3 scale depos from a laminar falling-film is analyzed. Theore models are presented, taking into account th fects of water composition and hydrodynamic ditions. The models demonstrate a method applying transport theories in analyzing diffusi effects occurring during scale deposition in a ing-film system. Analysis of experimental re

that diffusional effects can be of importance
n thin-film flow. The data may be used to
t the minimum expected CaCO sub 3 scale
tion rate in a laminar flow falling-film
under evaporative, nonboiling, conditions.
0472

IES ON SYNTHESES AND PERMEABI-
S OF SPECIAL POLYMER MEM-
ES. 40. FORMATION CONDITIONS OF
ER-LIKE CAVITIES OF CELLULOSE NI-
E MEMBRANES,
i Univ., Osaka (Japan). Dept. of Chemistry.
gami, Y. Ohsumi, and M. Sugihara.
nation, Vol 37, No 3, June 1981, p 293-305, 6
Tab, 13 Ref.

iptors: *Desalination, Desalination plants,
branes, Polymers, Finger-like cavities, *Cel-
nitrate membranes.

ermeation characteristics for polymer aque-
lution and asymmetric structure of cellulose
membranes, in particular the finger-like
in the back sponge layer of these mem-
, were investigated by changing the prepara-
conditions of the membranes - the casting
t, evaporation period, and gelation medium.
ormation of the finger-like cavity was de-
nt on absorption of a water molecule into the
g mixture from the atmosphere during the
t evaporation process and the exchange ve-
between the casting solvent and the gelation
m. The mechanism and conditions for the
tion of a finger-like cavity in cellulose nitrate
ranes were discussed.
0473

VERSIBLE FOULING CAUSED BY PLAS-
ZATION OF ASYMMETRIC REVERSE
OSIS MEMBRANES,
Motor Co., Dearborn, MI. Engineering and
rch Staff.
Anderson, M. E. Heyde, and H. K. Plummer,

ination, Vol 37, No 3, June 1981, p 307-311, 1
Tab, 10 Ref.

iptors: *Desalination, Desalination plants,
erse osmosis, *Membranes, Fouling, Plastici-
, Asymmetric membranes, Cellulose acetate.

n-scale reverse osmosis measurements have
performed on aqueous solutions of phenol, p-
henol, aniline, coumarin, sodium lauryl sul-
nd sodium naphtalene sulfonate. Asymmetric
ose acetate membranes were used. Low con-
ations of dissolved organics produce modest
sible reductions of permeate flux. Higher con-
ations of aniline dissolve the membrane, while
phenol concentrations effectively plasticize
embrane removing its asymmetric structure.
ron micrographs of plasticized and unplasti-
membranes are shown.
0474

HOTERIC MEMBRANE PREPARATION
THEIR APPLICATION TO SALINE
ER HYPERFILTRATION,
a Univ. (Italy). Inst. of Industrial Chemistry.
go, G. Capannelli, and S. Munari.
ination, Vol 37, No 3, June 1981, p 313-324,
g, 1 Tab, 17 Ref.

riptors: *Desalination, Desalination plants,
nbranes, *Hyperfiltration, Radiochemical
ng, Amphotevil membrane.

ew type of amphoteric membranes can be
esized by means of radiochemical grafting
ved by selective chemical reactions. Thus po-
fluoroethylene films were grafted with sty-
4-vinyl pyridine mixtures, and then reacted
chlorosulphonic acid and methyliodide to
n membranes containing both -SO-s ub 3 and -
H+ sub 3 groups. Such membranes were
d in a RO plant and their performances with
ish water checked.
-00475

UTILIZATION OF WASTE OF HOT WATER FOR DISTILLATION,
Indian Inst. of Tech., New Delhi. Centre of Energy Studies.
M. S. Sodha, A. Kumar, and G. N. Tiwari.
Desalination, Vol 37, No 3, June 1981, p 325-342, 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Desalination, Desalination plants, Distillation, *Solar stills, Wastewater utilization, *Heated water.

The yield of a solar still can be increased by introducing hot feed water available from power and chemical plants; even in the absence of sun appreciable yields are obtained. The performance of a solar still was studied in two modes of wastewater utilization: (1) Flowing waste hot water from thermal power plants of constant rate through the solar still, (2) Feeding waste hot water obtained from thermal power plants once a day. Dependence of the distillate output on various operating parameters was investigated.
W84-00476

ENGINEERING MANAGEMENT OF DESALINATION PLANTS IN SAUDI ARABIA USING FUZZY DECISION ANALYSIS,
Riyadh Univ. (Saudi Arabia). Coll. of Engineering.
A. F. Abdul-Fattah.
Desalination, Vol 37, No 3, June 1981, p 343-350, 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Desalination, Desalination plants, Management planning, *Saudi Arabia, Fuzzy set theory.

The fuzzy set theory is used in this analysis to help the decision-makers in selecting the most likely to succeed engineering management strategy for the operation of large desalination plants in Saudi Arabia. Five alternative strategies are suggested for the problem of desalination plants management. Fuzzy set theory and MAFDA computer code are used in the analysis. Fourteen criteria were selected. The final results show that the best solution is to use the computer and simulation strategy, and the second best is to use the local workers who had been trained in foreign countries.
W84-00477

EFFECT OF LIQUID TEMPERATURE ON SPRAY FLASH EVAPORATION,
Kyushu Univ., Fukuoka (Japan). Research Inst. of Industrial Science.
O. Miyatake, T. Tomimura, Y. Ide, M. Yuda, and T. Fujii.
Desalination, Vol 37, No 3, June 1981, p 351-366, 11 Fig, 1 Tab, 5 Ref.

Descriptors: *Desalination, Desalination plants, Spray evaporation, Temperature, *Evaporation, *Distillation.

To complement a previous experimental study of spray flash evaporation pursued at 60C jet inlet temperature, the effect was studied of liquid temperature on the spray flash evaporation by changing jet inlet temperatures to 40 and 80C. From the experimental results, a more general empirical equation suitable for predicting the variation of liquid temperature in the center of jet with residence time was deducted, and the recommendable operating conditions were proposed. Furthermore, an expedient method for prediction of the liquid temperature drop along the length of jet was devised for the recommendable operating conditions. Even at lower liquid temperatures, the spray flash evaporation still has higher evaporation performance and extremely faster evaporation rate than the flash evaporation occurring in other systems.
W84-00478

TEST AND EVALUATION OF 75,000 GALLON PER DAY CRYSTALEX PILOT PLANT.
Avco Systems Div., Wilmington, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-128602, Price codes: A04 in paper copy A01 in microfiche. Completion Report, March 1977. 55p 17 Fig. 4 Tab. 5 Ref. -3255(1) 14-30-3255.

Descriptors: *Desalination plants, *Pilot plants, *Mechanical engineering, *Performance evaluation, *Design criteria, Desalination apparatus, Desalination, Hydraulic engineering, Freezing, Refrigeration, Water treatment, Process control, Evaluation, Flow rates, Design standards, Design flow.

A constructed 75,000 gallon/day (gpd) secondary refrigerant freezing (SRF) plant was moved to the Office of Water Research and Technology's Test Station on the North Carolina coast for testing. The plant was constructed to demonstrate an SRF process which used a non-flammable secondary refrigerant (R-114, dichlorotetrafluoroethane) and incorporated features which would permit construction of transportable packaged plants in capacities up to 100,000 gpd. The plant differed from early comparable size SRF plants in that it used: a smaller pressurized counterwasher than gravity-drained washers, and many elements sized for flows for 125,000 gpd if the wash column and freezer performed appropriately. The overall process of the direct-contact SRF desalting plant is described, along with pilot plant operations and detailed descriptions of the plant equipment and its performance. Technical and process problems occurring during initial operations were resolved as encountered. While an inability for achieving acceptable performance levels in the pressurized counterwasher limited success for demonstrating a reliable economical freezing system, several significant objectives were achieved for continued freeze desalting assessment. Follow-on work will include installing a gravity wash column for continued pilot plant operation. (Zielinski - MAXIMA)
W84-00493

WORLD'S FIRST SOLAR POWERED REVERSE OSMOSIS DESALINATION PLANT,
Water Services of America, Inc., Milwaukee, WI.
W. W. Boesch.
Desalination, Vol 41, No 2, May 1982, p 233-237, 5 Fig.

Descriptors: *Desalination, Desalination plants, *Solar energy, Reverse osmosis.

Reliable water production to meet the drinking needs of small communiities using the technologies of seawater reverse osmosis (RO) and solar photovoltaic systems have been demonstrated. The abundance of sunshine in arid areas makes solar RO particularly viable. Reliable system operation without other power source backup supplies has also been demonstrated. A simple DC power arrangement for the complete system was shown to be effective. This demonstration system is the beginning of more and larger solar powered (RO) desalination systems.
W84-00503

STUDIES ON ALKALINE EARTH SULFITES - III(1). TRANSIENT SOLUBILITIES AND PHASE CHANGES OF CALCIUM SULFITE IN SEAWATER,
A. Cohen, M. Zangen, M. Koenigsbuch, and J. M. E. Goldschmidt.
Desalination, Vol 41, No 2, May 1982, p 215-232, 11 Tab, 4 Fig, 27 Ref.

Descriptors: *Desalination, *Sulphite pretreatment, *Seawater, *Calcium compounds, Alkaline earth sulfites, Calcium sulfite, Corrosion, Pretreatment of water.

Calcium sulfite was sufficiently soluble in seawater of various compositions to allow the use of SO sub 2 for pretreatment of seawater (to prevent corrosion and alkaline scale formation) in desalting plants. The solubility of calcium sulfite, prepared by mixing 0.4M solutions of Na sub 2 SO sub 3 and CaCl sub 2, in natural or synthetic seawater decreases with time and does not reach equilibrium for several weeks. Transient molal solubilities, at 25C after 20 min and 24 h, respectively, are 2.9 and 2.2 in natural seawater, 3.9 and 3.4 in 0.7M NaCl solution. This decrease is due to a gradual transformation, by a slow dissolution-recrystallization process, of a metastable phase of crystalline calcium sulfite into a more stable, less soluble, modifi-

cation observed by X-ray crystallography, scanning electron microscopy and thermal analysis. The addition of Na sub 2 SO sub 3 to natural seawater produced solutions strongly supersaturated with respect to calcium sulfite. These remained stable for extended periods, and were only slowly affected by solid calcium sulfite added later.
W84-00504

EFFECT OF RECOVERY ON DESALINATION OF THE BLACK SEA WATER BY REVERSE OSMOSIS,
Higher Inst. of Chemical Technology, Burgas (Bulgaria). Dept. of Water Technology.
I. Dobrevsky, V. Mavrov, and B. Bonev.
Desalination, Vol 41, No 2, May 1982, p 209-214, 2 Tab, 5 Fig, 2 Ref.

Descriptors: Desalination, Membranes, RO, Ultrafiltration, Reverse osmosis, Cellulose acetate, Tubular membranes, Black Sea, Brines, Pretreatment of water.

The effect of fresh water recovery was studied during Black Sea water reverse osmosis (RO) desalination with cellulose acetate tubular membranes. Two different schemes of brine pretreatment before RO were investigated. Ultrafiltration can be applied as an effective alternative method for Black Sea water pretreatment. Up to 30% recovery, the product flux as well as the salt and the specific ionic rejection are all fairly stable. Special experiments showed that in a stable turbulent regime Ca ions removal from Black Sea water before RO with tubular membranes hold out no technological advantages.
W84-00505

CHLORIDE/SULPHATE EXCHANGE OF ANION RESINS, KINETIC INVESTIGATION, VIII. INFLUENCE OF SOME PHYSICO-CHEMICAL PROPERTIES OF THE RESINS,
Istituto di Ricerca sulle Acque, Bari (Italy).
L. Liberti, R. Passino, and D. Petruzzelli.
Desalination, Vol 41, No 2, May 1982, p 199-207, 3 Tab, 4 Fig, 8 Ref.

Descriptors: *Desalination, Kinetics, Physicochemical properties, Chlorides, Sulphates, Chloride/Sulphate exchange, *Anion resins, *Resins.

Experimental exchange rates for C1-/SO4- exchange on strictly comparable anion resisn in 0.0006N solution confirm the unfavorable correlation between kinetics and selectivity. Evaluation of the influence of other physico-chemical properties of the resins (i.e. nature of matrix, type of amine, etc.) seems to support the hypothesis that chemical interactions, and not only diffusional effects, in the resin phase play a leading role on rate control. (Balaban-Boston)
W84-00506

PERFORMANCE EVALUATION AND PROCESS DESIGN OF AN ELECTRODIALYSIS PLANT BY OVERPOTENTIAL MEASUREMENTS,
Istituto di Ricerca sulle Acque, Bari (Italy).
R. Passino, C. Marra, A. Rozzi, and G. Tiravanti.
Desalination, Vol 41, No 2, May 1982, p 181-197, 1 Tab, 6 Fig, 18 Ref.

Descriptors: *Desalination, Desalination plants, *Electrodialysis plant, Membrane processes, Overpotential measurements, Ionics Mark III ED Stack.

The Ionics Mark III ED stack was investigated. The experimental techniques used allowed ED plant performance to be evaluated as a series of elementary subsystems; concentration boundary layer over-potentials were measured at different locations along the membrane flow path. The current interruption technique was used in order to calculate inter-facial concentrations and diffusion boundary layer thickness. The dependence was established of concentration polarization on membrane path length, the last membrane sections were strongly polarized even at relatively low operating current densities. A better ED plant design should make use of sequence of stack sections at different applied voltages.
W84-00507

MATHEMATICAL MODEL OF A MECHANICAL VAPOUR COMPRESSION EVAPORATOR. APPLICATION TO SEAWATER DESALTING. PART I - THE MODEL SETTLEMENT,
Institut de Genie Chimique de Toulouse (France).
D. Aussenac, S. Domenech, and M. Enjalbert.
Desalination, Vol 41, No 2, May 1982, p 137-169, 1 Tab, 1 Fig, 14 Ref.

Descriptors: *Desalination, Desalination plants, *Distillation, *Vapor compression evaporation, Numerical analysis, Mathematical models.

The performance is analyzed of a mechanical vapor compression evaporator used particularly for the production of fresh water by a process of seawater desalination. The setup of the pilot plant used is described, its performance is analyzed and a simulation mathematical model is established for the system. The exhaustive character of this model leads to a nonlinear system of 215 equations whose numerical analysis and solution are presented.
W84-00508

OPERATION OF MEFF DESALINATION PLANT (MULTIPLE EFFECT FALLING FILM PROCESS),
Toyo Engineering Corp., Tokyo (Japan).
S. Kido.
Desalination, Vol 41, No 2, May 1982, p 127-136, 6 Figs, 3 Ref.

Descriptors: *Desalination, Desalination plant, Desalination plants, *Multieffect distillation, Falling film, *Distillation, Jabal Dhana, Abu Dhabi, United Arab Emirates.

The 2273 cu.m/d MEFF (multiple effect falling film) sea water desalination plant, constructed by Toyo Engineering Corp. in Abu Dhabi, United Arab Emirates, is now in successful continuous operation. The MEFF process consists of evaporators, preheater, condenser and deaerators. Heat exchangers are designed with vertical tubes for heat transfer. Operation results have demonstrated excellent production capacity. The vertical condenser of the open air type enables tube maintenance during plant operation.
W84-00509

SHIP-MOUNTED SEAWATER 2500 CU M/D FLASH EVAPORATION PLANT FOR ABU-DHABI. ECONOMICAL DRINKING WATER FOR ARID REGIONS,
Buckau-Walther A.G., Essen (Germany, F.R.). Water Engineering Div.
K. Wangnick.
Desalination, Vol 41, No 2, May 1982, p 171-180, 7 Fig, 1 Tab.

Descriptors: Desalination, Desalination plants, Distillation, Flash evaporation, Ships, Abu-Dhabi, Arabian Gulf, Buckau-Walther(Krupp).

A ship-mounted seawater desalination plant was tranfered to the Water and Electricity Department of the Government of Abu Dhabi on February 6, 1982. This followed a 12-month construction period and two weeks of trials. Named the 'Rumaith', this is the first self-propelled floating seawater desalination plant built fo commercial use. The plant, consisting of a self-propelled pontoon-like hull carrying two centrally positioned desalination units of 1250 cu m each, will supply islands, coastal towns and major construction sites in the United Arab Emirates with drinking water and will also be deployed in the event of breakdown of stationary desalination plants, to provide an emergency water supply and to alleviate plantation water shortages. After handover, the vessel, accepted by German Lloyd for class + 100 A4K, was towed by tug to Abu Dhabi in the Arabian Gulf in 40 days. As general contractor, Buckau-Walther AG had the vessel built by Detlef Hegemann and Co. Industriewerke Unterwesser.
W84-00510

RECENT ADVANCES IN RO AND ED BRANE TECHNOLOGY,
Office of Water Research and Technology, ington, DC.
M. E. Mattson, and M. Lew.
Available from the National Technical Infor Service, Springfield, VA 22161 as PB84-1 Price codes: A03 in paper copy, A01 in micr Desalination, Vol 41, No 1, April 1982, p Fig, 13 Tab, 6 Ref.

Descriptors: *Desalination, Desalination Membranes, *Reverse osmosis, *Electrodi *Reviews.

The potential impact of recent developme both reverse osmosis and electrodialysis mem desalting technology is summarized. Particul phasis is given to the status of advanced te ogy reverse osmosis membranes with ch resistance having single pass seawater desali capability. Membranes capable of using low ating pressures for brackish water desaltin also reviewed. Results obtained with large type reverse osmosis modules and their po effect on lowering plant capital costs are pr ed. Possible elimination of acid and use of u tration as the predominant pretreatment s seawater desalination plants are also desc Recent developments in the high temperature trodialysis program for seawater desalting a the use of newly developed anion membran brackish water desalination are reviewed. Po impacts on future membrane desalination R a activity are discussed.
W84-00531

WATER, THE ESSENCE OF LIFE - AN IN NATIONAL CONGRESS ON DESALINA AND WATER REUSE,
CH2M Hill Southeast, Inc., Gainesville, FL.
O. K. Buros.
Desalination, Vol 41, No 1, April 1982, p 12

Descriptors: *Desalination, *Water reuse, views, International Congress, Bahrain.

A review of the International Congress on D nation and Water Reuse which was hel Manama, Bahrain from November 29 throug cember 3, 1981. This conference was sponsor the International Desalination and Environm Association (IDEA) and the State of Bah Ministry of Works, Power and Water. The co ence celebrated the 10th anniversary of the fo ing of IDEA.
W84-00532

RO SEPARATION OF RARE EARTH I FROM AQUEOUS SOLUTION BY HYDR FE OXIDE - CELLULOSE COMPOSITE M BRANE,
Tohoku Univ., Sendai (Japan). Dept. of Sci Engineering.
Y. Kurokawa.
Desalination, Vol 41, No 1, April 1982, p 115 2 Tab, 2 Fig, 6 Ref.

Descriptors: *Desalination, Desalination pl *Reverse osmosis, Membranes, Composite m brane, *Cellulose acetate, Iron oxides, Donnan exclusion effect.

The composite membrane was prepared by pregnation of hydrous iron oxide into a po cellulose acetate membrane which served as a port. The composite membrane looks like a bro ish solid solution. It has a magnetic susceptibili 1.50 x 10 super -5 emu/g. Rejection of inorg solute was increased by impregnation. The res to a certain extent interpreted in terms of Donnan ion exclusion effect.
W84-00533

RELIABILITY OF MSF PROCESSES BA ON OPERATION HISTORY,
Technology International, Inc., Ames, IA.
I. I. Kutbi, Z. A. Sabri, and A. A. Husseiny.
Desalination, Vol 41, No 1, April 1982, p 81-11 Tab, 15 Fig, 11 Ref.

ptors: *Desalination, Desalination plants, lation, *Multistage flash, Jeddah I, Reliabil- ult tree analysis.

ility of multistage flash (MSF) processes are ted using time-dependent fault tree analysis or critical systems. Failure data are obtained he operation records of Jeddah I since it is f the oldest plants still in operation in a ely harsh environment. Industrial failure re also used to complement historic data. nalysis shows areas where design improve- can be made to enhance MSF processes ility.
0534

OPERATION OF SEA WATER DISTILLA- AND PLANTS IN RELATION TO MATE- S SELECTION,
k and Partners Ltd., Brighton (England).
ton, and T. A. Douglas.
nation, Vol 41, No 1, April 1982, p 71-80, 1

ptors: *Desalination, Desalination plants, ater, *Distillation, Materials, Scaling, Addi- Ras Abu Fontas, Qatar, Jeddah, Saudi , Multistage flash distillation.

ional experiences are discussed with multis- ash distillation plants using both low and mperature chemical additive antiscale treat- The plants concerned are located at Ras ontas in the State of Qatar and have had lly good service experience; this is com- with acid dosed plants of similar overall located at Jeddah, Saudi Arabia.
0535

ATING EXPERIENCE OF MSF UNITS IN I ARABIA,
Water Conversion Corp., Jeddah (Saudi).
la.
nation, Vol 41, No 1, April 1982, p 57-69.

ptors: *Desalination, Desalination plants, stage flash distillation, *Scaling, Jeddah, Arabia, Additives, Acids.

di Arabia, the largest producer of water by 500 mgd), for scale control 28% of the units id and 60% use additive. It is critical to and modify operating parameters affecting ion since life-time can be reduced to 1/3 or not cared for. External aeration should be ith less than 20 ppb dissolved oxygen in the tor effluent for an acid treated unit. Low b 2 in the decarbonator effluent is recom- d to reduce corrosion in the Cu-Ni alloy and ternals.
0536

EFFECTS AND ORIENTATION EF- S IN ELECTRODIALYSIS,
niv. of New York.
glin, Y. Fang, and M. E. Green.
nation, Vol 41, No 1, April 1982, p 47-55, 1 Tab, 7 Ref.

ptors: *Desalination, Desalination plants, rodialysis, *Membranes, Critical current es.

t-voltage curves were measured, and criti- rent densities (CCD) determined, for several ers of one cation, and one anion, electrodia- embrane. The CCD has been found to be a sing function of membrane diameter; the are correlated by assuming that ions are ed from some distance from the edge of the ane. Results are adequately correlated if this e is taken to be 0.75 mm for the cationmem- and 0.25 mm for the anion membrane. This e is the same for NaCl and HCl for both anes. In addition to these measurements, has been determined as a function of mem- orientation. CCD decreases as the membrane d away from vertical, with the effect marked depletion layer is beneath the membrane.
0537

EFFECTS OF SURFACTANTS ON THE HY- PERFILTRATION PERFORMANCE OF DY- NAMIC MEMBRANES,
Clemson Univ., SC. Dept. of Chemistry and Geology.
R. J. Luppino, and H. G. Spencer.
Desalination, Vol 41, No 1, April 1982, p 33-45, 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Hyperfiltration, Dynamic membranes, *Surfactants, Zirconium oxide-polyacrylate.

The effects of surfactants on the permeability and the rejections of other solutes during hyperfiltration by zirconium oxide-polyuacrylate dynamic membranes on porous stainless steel tubes were investigated. The hyperfiltration performance was dependent on the type of surfactant and in some cases the effect was dependent on pH. The effects are attributable to the presence of surfactants at the feed-membrane interface and interactions with the membrane. Rejection is significantly increased at a small cost in permeability by the presence of an anionic surfactant. Large permeability declines occur when surfactant-membrane interactions are possible.
W84-00538

AN ANALYSIS OF THE PERFORMANCE OF A SPIRAL-WOUND ULTRAFILTRATION MEM- BRANE, WITH A TURBULENCE-PROMOTING NET,
Natal Univ., Durban (South Africa). Dept. of Chemical Engineering.
R. L. C. Flemmer, C. A. Buckley, and G. R. Groves.
Desalination, Vol 41, No 1, April 1982, p 25-32, 1 Fig, 12 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Mathematical models, Spiral wound, Ultrafiltration, Turbulence-promoting net, Gels.

A mathematical model was developed to describe the performance of a spiral-wound ultrafiltration module with a turbulence-promoting net. The model requires that certain constants be evaluated from tests on filtration modules and thereafter a simple relation is available to predict performance at varying concentrations and recirculation rates, under conditions of gel polarization.
W84-00539

MORPHOLOGICAL STUDY OF CELLULOSE ACETATE BENZOATE MEMBRANES BY SCANNING ELECTRON MICROSCOPY,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
M. D. Vyas, and I. C. Mody.
Desalination, Vol 42, No 1, July 1982, p 107-114, 10 Fig, 2 Ref.

Descriptors: *Desalination, *Membranes, Morphology, *Cellulose acetate membranes, Electron microscopy.

A Scanning Electron Microscope study undertaken to develop a morphological model to aid in predicting new membrane structures suitable for reverse osmosis membranes was undertaken. The cellulose acetate benzoate was studied and compared to cellulose acetate membranes.
W84-00616

DESALINATION OF BRACKISH WATER BY ELECTRODIALYSIS,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
W. P. Harkare, S. K. Adhikary, P. K. Narayanan, V. B. Bhayani, and N. J. Dave.
Desalination, Vol 42, No 1, July 1982, p 97-105, 5 Tab, 2 Fig, 2 Ref.

Descriptors: *Desalination, *Membrane processes, *Electrodialysis, Brackish water, Cation, Ion exchange.

The performance of an electrodialysis unit comprising interpolymer type cation and anion-exchange membranes developed in this institute in single-stage and two-stage operation for desalting of brackish waters having different total dissolved solids has been studied, highlighting the energy requirement and pressure drop under different conditions. For higher salinity waters, a two-stage reduction is advantageous with lower power requirements and power index. The results will be useful for design and installation of ED plants in brackish water sectors.
W84-00617

WETTABILITY AND BREAK-UP OF THIN FILMS ON INCLINED SURFACES WITH CON- TINUOUS AND INTERMITTENT FEED,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
D. M. Maron, G. Ingel, and N. Brauner.
Desalination, Vol 42, No 1, July 1982, p 87-96, 5 Fig, 15 Ref.

Descriptors: *Desalination, *Thin films, Wetting.

The conditions for complete wettability of dry or wet surfaces and film break-up were studied. The minimum wetting rates and critical rate before break-up were determined with various operation conditions, including liquid properties, temperature level and surface inclination. Two modes of liquid distribution at the top of the surface were considered, continuous and intermittent. The results are compared and discussed with reference to previous studies.
W84-00618

REVERSE OSMOSIS SEPARATION OF INOR- GANIC SALTS USING POLYVINYLALCOHOL MEMBRANES,
Erlangen-Nuernberg Univ. (Germany, F.R.). Inst. fuer Technische Chemie.
H. N. Chang.
Desalination, Vol 42, No 1, July 1982, p 63-77, 6 Tab, 2 Fig, 27 Ref.

Descriptors: *Desalination, *Membranes, *Reverse osmosis, Separation techniques, Inorganic compounds, Polyvinyl alcohol membrane.

Permeabilities and fluxes of fifty-four mono-, divalent anions and cations of sodium and chloride salts have been tested under experimental conditions of 50 bar and room temperature through asymmetric polyvinylalcohol membranes crosslinked with formaldehyde. The percentage rejections among these salts are: sodium salts of divalent anions (70-80%); chloride salts of divalent cations (30-40%); H sub 2 SO sub 4 (30%); sodium salts of monovalent monoatomic anions, chloride salts of monovalent cations (15-30%); and HCl, HNO sub 3, NaOH, KOH (10-20%). Sodium salts of monovalent polyatomic anions gave higher rejections than those of monovalent monoatomic anions. Higher rejection of divalent anions than that of divalent cations of chloride salts suggests that the membrane surface is negatively charged.
W84-00620

PREPARATION AND PROPERTIES OF A COMPOSITE CHARGED MEMBRANE,
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Technology.
D. A. Noordegraaf, C. A. Smolders, R. D. Boer, and D. J. Rimijn.
Desalination, Vol 41, No 3, June 1982, p 249-261, 5 Tab, 5 Fig, 22 Ref.

Descriptors: *Desalination, *Ultrafiltration, Membrane processes, *Membranes, Polyelectrolytes, Composite charged membrane, Poly(styrene sulfonate).

To develop a low pressure desalination membrane with fixed ionic charges, use was made of the normally unwanted crosslinking tendency in preparing the polyelectrolyte poly(styrene sulfonate) by sulfonation of polystyrene. After dipcoating a poly(sulfone) or poly(phenylene oxide) ultrafiltration (UF) membrane with a dilute solution of this

polyelectrolyte in water in the presence of some free sulfuric acid and silversulfate, fixation and cross-linking of the coating polymer took place by a heat treatment. Different membrane properties could be obtained by varying the pore size of the supporting UF membranes, and by variation in the coating polymer (M.W. concentration) and sulfuric acid concentration. Fluxes sometimes decline drastically in comparison with the original pure water flux; salt rejection values (at 1.5 g/l NaCl concentration and 0.5 MPa) never are very high (less than or equal to 60% for monovalent anions). The most important potential application for these membranes lies in their nonfouling properties.
W84-00621

A CONSIDERATION ON FLOW DISTRIBUTION IN AN ION EXCHANGE COMPARTMENT WITH SPACER,
Radiation Center of Osaka Prefecture, Osaka (Japan)
H. Miyoshi, T. Fukumoto, and T. Kataoka.
Desalination, Vol 42, No 1, Jul 1982, p 47-55, 2 Tab, 6 Fig, 6 Ref.

Descriptors: *Desalination, Membrane processes, Ion exchange, Eddy constant, Navier-Stokes equation, *Fluid mechanics.

The flow distribution in an ion exchange compartment with a spacer is necessary to analyze the mass transfer in the compartment. An equation on the flow distribution in the compartment was theoretically derived by substituting the eddy viscosity of the spacer to the Navier-Stokes equation. The values of the eddy constant contained in the eddy viscosity were indirectly measured, and an experimental equation for estimating the eddy constant is given.
W84-00622

THE COURTAULDS DESALINATION PROCESS,
Courtaulds Ltd., Coventry (England).
D. C. F. Pratt.
Desalination, Vol 42, No 1, July 1982, p 37-45, 1 Fig.

Descriptors: *Desalination, *Distillation plants, *Vapor compression, Plastics, Heat transfer, Courtalds process.

The development of a practical form of plastic heat transfer surface is described and reasons are given for adopting a particular type of configuration. The use of this surface to give very low energy vapor recompression desalination is outlined along with the layout of a fullscale distiller unit. Expected energy consumption figures are given.
W84-00623

VERTICAL TUBE FOAM EVAPORATION FOR WATER DESALINATION,
Envirotech-Sephton Development Center, Emeryville, CA.
H. H. Sephton.
Desalination, Vol 42, No 1, July 1982, p 27-35, 4 Fig, 14 Ref.

Descriptors: *Desalination, *Distillation, Vertical tube foam evaporation, Evaporator.

Vertical tube foam evaporation (VTFE) provides a method of enhancing evaporator performance substantially by increasing the brine-side heat transfer coefficient. It reduces the temperature needed to drive evaporation and the energy required; consequently, the evaporation rate of evaporator capacity is increased under constant temperature conditions. VTFE applied to multiple effect evaporators, to evaporate with vapor compression to drive the process and to waste-heat evaporation of aquaious solutions are illustrated by test data obtained with pilot plants operated under realistic process conditions and utilizing full-size distillation tubes.
W84-00624

THE CHANGING FACE OF DESALINATION - A CONSULTING ENGINEER'S VIEWPOINT,
Binnie and Partners, London (England).
F. C. Wood.
Desalination, Vol 42, No 1, July 1982, p 17-25, 3 Tab, 2 Fig, 11 Ref.

Descriptors: *Desalination, Desalination plants, *Distillation, *Reverse osmosis, Solar, *Economic evaluations, Forecasting, Multistage flash.

The present major market for desalting plants will continue to rely mainly upon the proven multistage flash process until local policy dictates a need for resources conservation or the long-term merits of reverse osmosis (RO), as well as its high energy-efficiency, are well established. On the other hand, industrialized, oil-importing countries, with increasing water shortages and environmental contraints, must develop energy-efficient processes for single- and dual-purpose operation as well as improve RO membranes for desalting of seawater. The needs of small-plant users require particular consideration if the simple yet reliable plants which their circumstances demand are to be satisfied. Solar plants are likely to find their initial commercial applications in this market.
W84-00625

THE PURAQ SEAWATER DESALINATION PROCESS,
Puraq Co., New Haven, CT.
L. Lazare.
Desalination, Vol 42, No 1, July 1982, p 11-16, 3 Fig.

Descriptors: Desalination, Seawater, Liquid-liquid extraction, Polymeric solvent, Puraq, Polymers.

The Puraq seawater desalination process is based on the liquid-liquid extraction of product water using a polymeric solvent, custom-synthesized to satisfy a particular set of design conditions, namely maximum seawater temperature and salinity.
W84-00626

TECHNOLOGICAL AND ENVIRONMENTAL ASPECTS OF DESALINATION,
R. S. Silver.
Desalination, Vol 42, No 1, July 1982. p 1-9.

Descriptors: *Desalination, *History, Industrial water social needs, *Social aspects.

The industrial and sociological importance of desalination, and its place in the nexus of chemical engineering are surveyed. The history of its development, particularly in the last two decades, is reviewed, and the risky task of foreseeing the next 20 years in the field is attempted. For this latter task there is a crystal ball provided by the laws of thermodynamics, but unfortunately the crystal view is frequently distorted by inadequate understanding of these principles and their application. A fundamental analysis is given of desalination processes in terms of thermodynamics, demonstrating the interaction between practical necessities and thermodynamic imperatives. It is shown how the implications of this analysis have been confirmed by the history of development, and so suggests confidence in the interpretation for the future. All signals are subject to distortion by noise, and reference is made to the main sources of noise in this subject, which vary from the shrill sounds of the marketplace through the sombre notes of fiscal policies to the cacophony of politics.
W84-00627

ALCOHOL REDUCTION IN BEER BY MEANS OF DIALYSIS,
Wickuler-Kupper-Brauerei K.G., Wuppertal (Germany, F.R.).
H. Moonen, and H. J. Niefind.
Desalination, Vol 41, No 3, June 1982, p 327-335, 3 Tab, 6 Fig, 8 Ref.

Descriptors: *Desalination, *Membrane processes, Dialysis, Hollow fiber membranes, *Beer, Alcohols.

A process to reduce the alcohol content of b
presented based on the principle of dialys
selectivity is demonstrated by carbohydrate
tra and other analytic data. A large-scale pilo
in use for more than one year, is described
membranes are hollow fibers with a total area
sq m. The unit produces 1,500 /h of dietetic
whose alcohol content is reduced by 40%.
performance of the unit and the degree of al
reduction can be controlled within narrow l
W84-00628

RECYCLING OF DETERGENTS AFTER TRAFILTRATION OF CLEANING SO TIONS,
Daimler-Benz A.G., Stuttgart (Germany, F
H. Paul.
Desalination, Vol 41, No 3, June 1982, p 313-3
Tab, 8 Fig.

Descriptors: *Desalination, *Ultrafiltration, F
cling, *Detergents.

Experiments showed that a recycling of deter
after separation by an UF process is possible
out any risks to production. Considerable sa
in operating costs as well as a simultaneous
charge of the waste water can be expected.
result of the experience gained, the range of a
cation of membrane technology, in this case
has been extended to an important range of a
cation, a fact which is of major importance fo
future. Tests with respect to optimizing the re
ery of detergent substances by changing the
draulic values of UF systems are at present b
carried out in collaboration with the Institut
Chemical Engineering at Aachen.
W84-00629

BIOTECHNICAL APPLICATIONS OF PLEATED CROSSFLOW MICROFILTRAT MODULE,
Membrane Filtration Technology, Inc., Reho
(Israel).
G. B. Tanny, D. Hauk, and U. Merin.
Desalination, Vol 41, No 3, June 1982, p 299-3
Tab, 10 Figs, 17 Ref.

Descriptors: *Desalination, *Membrane proce
*Ultrafiltration, Pleated crossflow microfiltra
module, Low pressure membrane, Microor
isms, Protein separation, *Cheese, Whey, Bu
fat.

The use of a pleated, tangential flow microfil
tion module was investigated in the context
areas of biotechnology: (a) industrial scale harv
ing of microorganisms; (b) diafiltrative separa
of a low molecular weight protein, from a hom
enate of soft animal tissue; and (c) the remova
fat and casein particles from cheese whey prio
concentration of the whey by ultrafiltration. In
applications, low pressure membrane microfil
tion technology can be used to either improve
overall efficiency and performance of centrifu
separations or to replace them entirely. In the c
of prefiltration of cheese whey, significant
provement was achieved both for the recovery
butter fat as well as increased UF membrane fl
rates in the concentration step.
W84-00630

SIMULTANEOUS AUTOMATIC MEASUR MENT OF SALT AND WATER FLUX THROUGH A CHARGED MEMBRANE,
Rouen Univ., Mont-Saint-Aignan (France). L
de Chimie Macromoleculaire.
C. Ripoll, M. Labbe, L. Lavielle, and E. Selegny
Desalination, Vol 41, No 3, June 1982, p 289-298
Tab, 5 Fig, 8 Ref.

Descriptors: *Desalination, *Membrane process
Feedback controled system, *Sulfonated polye
ylene membrane, Cations.

A feedback controlled system is proposed whi
maintains constant concentrations of solutions
both sides of a membrane. The constancy is o
tained by feeding each half cell with amounts
suitable adjusting solutions. Both Salt flux, J su

er flux, J sub w are deduced from addition
is of special interest that the system allows
eous measurement of both fluxes, in abso-
ontrolled steady state conditions. The
s analyzed on the basis of the methods of
cs. The reliability of the controlling
as been tested by comparing the value
d for known fluxes imposed through capil-
nulating a membrane. Data are given for a
ed polyethylene cation exchange mem-

631

ROSPECTS OF WATER REMOVAL BY FILTRATION USING THIN FILM OSITE MEMBRANES,
Sukkerfabrikker, Nakskov. Driftteknisk
ielsen, and S. Kristensen.
tion, Vol 41, No 3, June 1982, p 277-288, 1
ig, 7 Ref.

ors: *Desalination, *Membranes, *Hyper-
, Plate-and-frame system, Thin-film com-
embrane, Orange juice concentration.

lm composite membrane (HR) was superi-
membranes in its pure water flux and salt
, rejection of low molecular weight organ-
ounds, temperature and pH stability, and
against chemicals. The membrane was de-
for water desalination, but its greatly im-
properties increase the applicability of hy-
tion for water removal in many fields. To
rom HR membrane superiority, the plate-
ne system was also improved. Experiments
perfiltration using HR membranes at a
ture as high as 80C were carried out on
ce from the beet sugar industry. A pilot
orking at 30 bar and 80C for one month
omising results in spite of the extreme
ration operating conditions. Promising re-
re obtained with the HR membranes work-
0 bar and 60C on fermentation broth from
oduction. For these applications, the possi-
of using strong acid and strong alkaline
agents were useful. Preliminary experi-
n hyperfiltration of orange juice indicated
HR membranes have a greatly improved
n of aroma carrying compounds, thus im-
the possibilities of using hyperfiltration for
uice concentration.
632

**R TO THE EDITOR ON PAPER PUB-
O IN DESALINATION VOL 41(1982) 57-
.NADA: OPERATING EXPERIENCE IN
NITS IN SAUDI ARABIA,**
GEIGY Plastics and Additives Co., Man-
(England). Industrial Chemicals Div.
ddenbrook.
tion, Vol 41, No 3, p 337.

tors: Desalination, Distillation, MSF, Scale
Additive vs acid treatment, Belgard EV,
rabia.

denbrook maintains that, contrary to the
y Nada, Belgard EV performs successfully
t-effectively and this is described by R.
and T. A. Douglas in Desalination 41
1-80. (The operation of seawater distilla-
nts in relation to materials selection).
633

**EEDINGS OF THE SYMPOSIUM ON
RANE TECHNOLOGY IN THE 80'S,
, SWEDEN, SEPTEMBER 29 - OCTO-
1980.**
niv. (Sweden).
trom, and M. Balaban.
ation, Vol 35, Vols 1/2/3, December 1980,

tors: *Membranes, *Desalination, Dairy in-
Chemical industry, Pharmaceutical indus-
technology.

containing the Proceedings of the Sympo-
n Membrane Technology in the 80's with the participation of scientists and engineers in the field. This volume contains 29 papers on membrane technology for desalination and other industries.
W84-00687

SYNTHETIC MEMBRANES: STATE OF THE ART,
Max-Planck-Inst. fuer Biophysik, Frankfurt am Main (Germany, F.R.).
W. Pusch, and A. Walch.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 5-20, 2 Tab, 14 Fig, 46 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Review, Reverse osmosis, Electrodialysis.

Synthetic membranes are used for a great variety of separation processes such as dialysis, electrodialysis, hemodialysis and hemofiltration, ultra- and hyperfiltration, and pervaporation, where the process is generally designated according to the applied driving force such as a concentration, electrical potential, or pressure difference, respectively, across the membrane. A great deal of work was spent during the last 25 years for the development of the best possible membranes using almost every available polymeric material. At the beginning of membrane research, natural polymers such as cellulose and cellulose derivatives were essentially employed for the preparation of appropriate membranes such as collodion and cellulose acetate, for instance. These polymeric materials were rediscovered for the preparation of desalination membranes installed into hyperfiltration modules for the production of fresh water from brackish and seawater. In this connection, new membrane structures and configurations were designed besides the common homogeneous flat sheet membrane in order to meet the demands of high flux and high packaging density of a corresponding membrane module. With respect to an improved packaging density, spiral-wound, tubular, capillary, and hollow-fine fiber modules were designed in addition to the classical plate and frame module. Moreover, asymmetric and so-called composite membranes were developed to generate high flux membranes possessing the same selectivity as the corresponding homogeneous ones. Concurrently with the development of new membrane structures and configurations, new polymeric materials such as polyamides, polymides and polybenzimidazolone were cast into membranes improved transport properties and chemical resistivity.
W84-00688

OVERVIEW OF THEORIES FOR WATER AND SOLUTE TRANSPORT IN UF/RO MEMBRANES,
Technical Univ. of Denmark, Lyngby. Inst. for Kemindustri.
G. Jonsson.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 21-38, 7 Fig, 15 Ref.

Descriptors: *Desalination, Desalination plants, Reverse osmosis, Ultrafiltration, Membranes, *Solute transport.

The applicability of various models for the transport of water and solute in UF/RO membranes is briefly outlined. The selectivity of various solutes in ultrafiltration (UF) and reverse osmosis (RO) is discussed.
W84-00689

DEVELOPMENT OF NEW MEMBRANES,
Forschungsinstitut Berghof G.m.b.H., Tuebingen (Germany, F.R.).
H. Strathmann.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 39-58, 14 Fig, 29 Ref.

Descriptors: *Review, *Desalination, Desalination plants, *Membranes, Hyperfiltration, Ultrafiltration, Polymers, Cellulose acetate, Polysulfone, Polyamide.

Asymmetric membranes made from various polymers, such as cellulose acetate, polysulfone, polyamide, etc. by a phase inversion process are widely used today in ultra- and hyperfiltration. In spite of their good filtration properties, these membranes have certain short-comings as far as their selectivity and chemical stability are concerned. Considerable effort has therefore been spent in recent years to develop new membranes with better separation characteristics and better overall properties tailormade for special applications. For desalination of sea- and brackish waters, e.g., composite membranes with better chemical stability and higher fluxes and salt rejection have been developed. For the treatment of certain industrial effluents, liquid membranes with carrier facilitated transport properties for certain metal ions are available today. Membrane preparation techniques are no longer limited to the phase inversion process; track etching procedures, plasma polymerization and radiation induced grafting are used today to produce membranes for various applications. Recent developments in the preparation techniques of membranes and membrane materials are reviewed.
W84-00690

CONCENTRATION POLARIZATION AND FOULING,
Lund Univ. (Sweden). Food Engineering Div.
E. Matthiasson, and B. Sivik.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 59-103, 3 Tab, 7 Fig, 143 Ref.

Descriptors: *Membranes processes, *Polarization, *Desalination, Seawater, Membranes, Fouling.

Concentration polarization is often the reason for the serious limitation of the membrane processes due to its negative influence on the transmembrane flux. Many theoretical studies on this polarization phenomena have resulted in mathematical models for concentration polarization. In most of them, solutions are sought for the coupled nonlinear system of the equations of continuity and motion. Each of these solutions makes use of some assumptions in order to simplify the equations which represent the phenomenon. Different kinds of flow systems have been constructed in order to reduce the concentration polarization. The aim of these flow systems has mainly been to improve the mass transport from the membrane surface back to the bulk solution. Fouling often is a result of concentration polarization, but can also have other reasons. Unveiling the basic mechanisms of fouling attracted little attention until the late seventies, when for example, fouling of an RO seawater desalination membrane could be subdivided into four consecutive steps. Studies of the chemistry and physics of fouling were performed on whey and revealed in close detail some of the responsible phenomena.
W84-00691

INTERFACIAL PHENOMENA - BIOADHESION AND BIOCOMPATIBILITY,
Lund Univ. (Sweden). Food Technology Div.
K. Larsson.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 105-114.

Descriptors: Synthetic membranes, *Fouling, *Membrane processes, Bioadhesion (fouling), Biocompatibility.

The physical-chemical interaction between components of biological fluids and solid materials is considered with regard to performance of synthetic membranes. The possibilities to reduce irreversible bioadhesion (fouling) of membranes, and to achieve biocompatibility, are discussed on the basis of the theory of colloidal adhesion, recent knowl-

edge on so-called hydration forces, and experiences with biomaterials.
W84-00692

ULTRAFILTRATION AT LOW DEGREES OF CONCENTRATION POLARIZATION: TECHNICAL POSSIBILITIES,
Lund Univ. (Sweden). Food Engineering Div.
M. Lopez-Leiva.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 115-128, 2 Tab, 9 Fig, 11 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, Ultrafiltration, *Concentration polarization, Plate-and-frame membrane.

The phenomenon of concentration polarization (CP) produces well known deleterious effects in ultrafiltration (UF), the most important being the many-fold diminishing of trans-membrane flux. Classical methods used to decrease this negative influence have made use of either a turbulent flow or a high shear stress laminar flow past the membrane. In both cases the liquid is recirculated through the UF module until the desired degree of concentration is obtained. The same type of flow can be obtained either by moving the membrane in relation to the liquid or by moving a surface parallel to the membrane. Here the velocity of the fluid across the module is irrelevant and consequently it can be set according to the degree of concentration required. Two modules working with this principle are presented. One of laboratory-scale size is composed of a pair of concentric cylinders of which the inner one, carrying the semipermeable membrane, is rotatable. The other module, of around 0.6-sq m membrane area, is of the rotary 'plate-and-frame' type. Energy consumption curves for each module as well as their performance in the ultrafiltration of BSA solutions and milk are presented.
W84-00693

FOULING OF ULTRAFILTRATION MEMBRANES: LATERAL MIGRATION AND THE PARTICLE TRAJECTORY MODEL,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
G. Green, and G. Belfort.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 129-147, 6 Fig, 48 Ref.

Descriptors: *Membranes, *Ultrafiltration, Fouling, Colloids, Lateral migration, *'Flux-paradox' problem.

Lateral migration theory is used both to explain the 'flux-paradox' problem for colloidal suspensions and as part of the standard filtration theory for calculating permeation flux as a function of time. Particle trajectory analysis is used to model the physics of colloidal fouling in tangential flow ultrafiltration. A method is also suggested on how to incorporate trajectory analysis into the standard filtration theory. The theoretical results are compared with experiments from the literature and from the author's laboratory.
W84-00694

EVALUATION OF STATIC MIXERS AS CONVECTION PROMOTERS IN THE ULTRAFILTRATION OF DAIRY LIQUIDS,
Nederlands Inst. voor Zuivelonderzoek, Ede.
J. Hiddink, D. Kloosterboer, and S. Bruin.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 149-167, 6 Tab, 6 Fig, 17 Ref

Descriptors: *Membranes, *Ultrafiltration, *Dairy industry, Static mixer, Milk.

The efficiency was determined of various types of static mixer (variants of the Kenics type) for enhancing the permeate flux in ultrafiltration plants. A theoretical analysis of the transport phenomena that occur in the laminar-flow region in a tube divided into two half-cylindrical channels, showed that the mass transfer coefficient increased by a factor 1.95 as compared with that in a cylindrical tube. The increase in permeate flux obtained in the experiments, amounted to a factor 2.9. This extra effect should be attributed to rotation of the liquid and changes in the direction of rotation, caused by the static mixers. At equal energy input levels, approximately equal permeate fluxes were achieved in both the laminar-flow and the turbulent-flow region, whether static mixers were used or not. The types of static mixer tested did little to improve the energy efficiency in ultrafiltration plants under the prevailing conditions.
W84-00695

MEMBRANE PROCESSES IN THE DAIRY INDUSTRY,
Nederlands Inst. voor Zuivelonderzoek, Ede.
R. De Boer, and J. Hiddink.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 169-192, 1 Tab, 13 Fig, 44 Ref.

Descriptors: *Membranes, *Ultrafiltration, *Reverse osmosis, Milk, Whey, Cellulose acetate, *Dairy industry.

From the increase in the ultrafiltration (UF) and reverse osmosis (RO) membrane surface, considerable progress has been made in the dairy industry during the last 10 years. This development will continue in the eighties. The increase in energy prices wil favour the development of RO, not only for whey but, due to an increase permeate flux, also for milk. In addition to concentration before transport to centralized plants the manufacture of milk products from concentrated milk will be also of interest. A developing whey protein market for products with 35%, 60% and 80% protein and a more stringent pollution control, which will force the dairy industry to process their whey, will influence th application of UF positively. The use of UF for the manufacture of a variety of cheeses from fresh to semi-hard cheese is a possibility now. An important point in this development is that the manufacturers of equipment offer complete production lines. A by-product of UF is the permeate with its high lactose content, and possibilities for profitable use have recently become available. To achieve a higher permeate flux pretreatment of the starting liquid has to be applied in many cases. Fouling of the membranes is particularly caused by calcium phosphate. Proteins play some role. More research is necessary before these phenomena are fully understood. Not only the pretreatment but also the bacteriological aspects are a specific problem for the dairy industry. Especially in cases of RO at 30C - the maximum process temperature for cellulose acetate membranes - continuous attention to cleaning and disinfection is necessary.
W84-00696

PRODUCTION OF WHEY PROTEIN CONCENTRATES WITH HIGH SOLIDS CONTENT,
Pasilac A/S, Silkeborg (Denmark).
J. Rubin.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 193-199, 4 Tab, 3 Fig.

Descriptors: *Ultrafiltration, *Dairy industry, Milk, Membranes, *Whey, Proteins.

Ultrafiltration is very useful in production of whey protein powders. The protein concentrates obtained by this process seldom have a solid content higher than about 20%, and it is very difficult to evaporate, especially concentrates with relatively high protein contents. This means that a large part of the whey protein concentrates produced today is spray dried directly which in turn is costly and may give troubles with e.g. light and bulky powders. At experiments on a DDS 20-cm laboratory module it was possible to concentrate whey protein concentrates with about 80% protein in solids to more than 35% total solids. A number of filtration and ultrafiltration membranes were at temperatures up to 50C and varying pre Using ultrafiltration membranes further g increase in the relative protein content of th centrate. Results obtained on the lab-modul later confirmed on a DDS/Pasilac pilot pla a 7 sq m 30-cm module equipment with G membranes. The pilot plant was operated b batch and in continuous mode. The final c trates could be 'pasteurized' at 66C for 15 s but blocked the pasteurizer at 69C. Spray dr the product using a nozzle atomizer was unc cated and gave a relatively high bulk density resulting powders.
W84-00697

CONCENTRATION OF RAW WHOLE BY REVERSE OSMOSIS AND ITS INFLU ON FAT GLOBULES,
Nederlands Inst. voor Zuivelonderzoek, Ede
R. De Boer, and P. F. C. Nooy.
Desalination, Vol 35, Nos 1/2/3, Decembe (Comprising the Proceedings of the Symposi Membrane Technology in the 80's, Ystad, Sw Sept. 29-Oct. 1, 1980), p 201-211, 5 Tab, 3 F Ref.

Descriptors: *Reverse osmosis, Tubular reve mosis, *Dairy industry, *Milk, Filtration,

Raw whole milk was twofold concentrate tubular reverse osmosis (RO) system. Meth preventing damage being caused to the m globules were investigated. Fat damage - ch by the BDI method and homogenization deg induced particularly by the normal pressure valves. The use of a capillary tube, press removal (dead-end filtration) or cooling of th before the normal pressure relief valve belo prevented damage to the milk fat. This last m can be applied in a continuous process as wel a batch process. The twofold concentrated derived from the various procedures were at 4C during two to three days, no increase i value took place. Cultured butter made fro centrated milk had a higher diacetyl content more sweet and acid flavour (yoghurt-like) control butter, which is probably the outcom higher solids-not-fat content. No rancid o vours could be detected in the butter made concentrated milk, while during cold stora development of off-flavours of an oxidative acter took place. In addition to the product q attention was also paid to the lay-out of installation based on the principle of dead-e tration.
W84-00698

PRODUCTION AND PROPERTIES OF GHURT AND YMER MADE FROM UL FILTRATED MILK,
Statens Forsoegsmejeri, Hilleroed (Denmark)
G. Mogensen.
Desalination, Vol 35, Nos 1/2/3, December (Comprising the Proceedings of the Symposiu Membrane Technology in the 80's, Ystad, Sw Sept 29-Oct 1, 1980), p 213-222, 3 Tab, 7

Descriptors: *Ultrafiltration, *Dairy ind Milk, Yoghurt, Ymer.

Yoghurt and Ymer are examples of ferm products which are concentrated in solids n (SNF). Ymer is a Danish dairy product wh heavily concentrated. According to Danish le tion it must contain at least 6% milk protein a least 11% SNF. Originally this concentration achieved by draining off 50% whey after ferm tion. The development of ultrafiltration (UF) industrial scale opened new possibilities to tate standardization of SNF, increase product and rationalize the production. The chemical position of ymer made from ultrafiltrated differs, however that prepared in the tradit way. Presumably due to the increased conte calcium and phosphorus, UF-ymer is liable t velop a brittle consistency just as the flavo changed unfavourably. Research has shown the retention of calcium and phosphorus is aff by the heat treatment of the milk prior to UF

perature at which the milk is ultrafiltrated. fluence on product consistency is rather ble and the small decrease in calcium reten- ower filtration temperature could not com- for the decrease in filtration capacity. Be- f the changed chemical composition of the er, the manufacturing technology has to be d.
699

VIEW OF CONCENTRATION POLAR- ON IN ULTRAFILTRATION,
tural Univ., Wageningen (Netherlands). Process Engineering.
n, A. Kikkert, J. A. G. Weldring, and J.
ation, Vol 35, Nos 1/2/3, December 1980 ising the Proceedings of the Symposium on ane Technology in the 80's, Ystad, Sweden,) - Oct. 1, 1980), p 223-242, 17 Fig, 53 Ref.

tors: *Ultrafiltration, Concentration polar- Milk, Whey, *Dairy industry.

tration polarization mechanisms are briefly d. A morphological analysis of ways to the detrimental influence on membrane s given. The potentials of these different ches are analysed and some examples of designs resulting from the various ap- es are given. Particular emphasis is given to of the physical-mechanical properties of layer in the ultrafiltration of milk whey in a ultrafiltration module.
700

Water Yield Improvement

O STUDIES IN GREENLAND,
nd Technical Organization, Copenhagen rk).
angager.
tional Water Power and Dam Construction, , No 2, p 43-45, February, 1983. 2 Fig.

tors: *Hydroelectric power, *Planning, resources development, Greenland, Gla- unoff, Snow melt, Melting.

ied energy planning indicates that hydro- is the most favorable alternative to import- as an energy source for Greenland. The 's current energy supply situation is re- , and a new energy plan prepared by the y of Greenland in 1981 is summarized. De- e given of the quantities of hydropower could be exploited and of current investiga- oncerning the hydrological basis for exploi- Current hydrological and glaciological in- tions aim to define the resource at a particu- el of certainty. Not only the ice mass bal- of interest, but also the dynamic condition, runoff pattern has changed considerably of the ice front back melting. The final with dam levels, power station elevation, nical and electrical equipment will depend keting conditions and the type of financing le. The entire project will be evaluated with rgy plan in connection with coal- and oil- nergy production. An example of a site for ntial powerplant subject to comprehensive gations is near the town of Jakobshavn the inlet of Pakitsup ilordlia is situated, 35 he north. Studies have indicated the natural which might be used as reservoirs, potential cations and potential waterways with power locations. The basin itself has uncertain ce limitations. (Baker-FRC)
393

E SCALE DEW COLLECTION AS A CE OF FRESH WATER SUPPLY,
Univ., Gainesville. Dept. of Mechanical ering.
Rajvanshi.
nation, Vol 36, No 3, March 1981, p 299-306, 2 Tab, 13 Ref.

ptors: *Water supply, *Condensation, Pota- ter, *Dew, Moisture.

A scheme for large-scale dew collection as a source of fresh water supply is outlined. The scheme envisages bringing cold seawater (5C) from about 500 meters depth and about 5 km from the shore, in 4, 1.22-m diam plastic pipes. It then passes through a heat exchanger field with an area of 129,000 cu m (1,390,000 sq ft) where it condenses 643 cu m of dew over the 24-hour period. The pumping of seawater from the sea and through the field is accomplished by three 200-kW wind machines. Technical and economical feasibility of the scheme is analyzed and the possibility of marine culture as a source of food is explored. The present scheme is economically not feasible as compared to a reverse osmosis facility of equivalent capacity.
W84-00469

GROUNDWATER SPRINGS TO CAPE VERDES' AID.
World Water, Vol 5, No 12, p 32-33, December, 1982.

Descriptors: Water resources development, *Groundwater, *Developing countries, *Cape Verde, Faja Tunnel, Tunnels, Water distribution, Wells.

Groundwater supplies are being developed in the Cape Verde archipelago, which has virtually no surface waters and is subject to severe droughts. In addition to many wells being drilled, the 2200 m Faja tunnel, scheduled for commissioning in 1985, will carry groundwater by gravity flow from the foot of Monte Gordo to an agricultural area. Electrical and hand pumps are being used. Two wells equipped with wind-powered generations have been installed. (Cassar-FRC)
W84-00585

3D. Conservation In Domestic and Municipal Use

WATER MANAGEMENT INITIATIVES IN THE COMMONWEALTH,
G. M. Lovejoy, III.
Water/Engineering and Management, Vol 130, No 3, p 30-32, March, 1983. 2 Tab.

Descriptors: *Water management, *Water shortage, *Industrial water, *Massachusetts, Water supply, Water demand, Financing, Water conservation, Legislation, Municipal water, Prices, Water rates, Water distribution, Water treatment.

Although Massachusetts has an average annual rainfall of 46 inches, water shortages occur in some sections of the state during dry periods as a result of mismanagement. A comprehensive water management and protection bond program, Chapter 286 of the Acts of 1982, signed by the governor on July 10, is designed to expand current programs and create new ones. Most of the programs are matching programs. All communities must devise a comprehensive water resource management plan. In case of water emergency, a community applies to the state for Chapter 40 approval, which provides powers to enforce water conservation measures, giving priority to water for drinking and fire protection at the expense of manufacturing. Of the total $357.5 million program, $205 million is allocated to publicly owned wastewater treatment facilities and sewers and $60 million to leak detection and rehabilitation of water supply systems. Water management methods for several of the state's communities include increased water rates and use of a flat rate instead of block rate. As a result, industry has initiated water conservation procedures. (Cassar-FRC)
W84-00483

SUMMARY REPORT ON DROUGHT PLANNING BY COMMUNITY WATER SYSTEMS.
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
April 1982. 33 p, 5 Fig, 1 Tab, 4 Append.

Descriptors: *Drought, *Water deficit, *Water shortage, *Urban watersheds, *Reservoir storage, *Water supply, Water level recorders, Water table decline, Water table fluctuations, Water conservtion, Planning, Resources development.

Precipitation during the summer and fall of 1980 in the Southeast area of New York State was substantially below normal and resulted in what has become known as the drought of 1980-81. Total precipitation for 1980 averaged 36.86 in., a deficit of about 8 in. from the mean of 44.93 in. Subsequent studies found that emergency sources were, in general, readily available for most community water systems with the exception of the New York City system and systems in Westchester and Rockland Counties. In addition, New York City made significant conservation efforts which resulted in an overall reduction in water usage of more 200 mgd. Westchester County, in which 79% of the population depends on New York City's reservoir system, has very few usable emergency sources and, therefore, must rely primarily on reducing water usage during periods of drought. In Rockland County, excessive releases from Lake DeForest can be prevented by new opeating regulations. Recommendations for suppliers of water are: (1) water source level monitoring; (2) reservoir volume measurements; (3) new source development; (4) metering of community water systems; (5) emergency source sampling program; (6) emergency source construction or rehabilitation; and (7) emergency equipment stockpile improvement. Additional recommendations are made for regional water management. (Garrison-Omniplan)
W84-00500

3E. Conservation In Industry

REUSING COOLING WATER IN AN ELECTRIC POWER PLANT,
Burns and McDonnell, Kansas City, MO.
W. P. Grobmyer, W. J. Wilson, J. F. Hancock, and M. L. Kurtz.
Journal of the American Water Works Association, Vol 75, No 3, p 119-123, March, 1983. 3 Fig, 2 Tab.

Descriptors: *Cooling water, *Industrial wastewater, *Zero discharge, *Water reuse, Powerplants, Wastewater treatment, Water conservation, Landfills, Deerhaven Station, FLorida, Water quality control, Dissolved solids, Brines.

The Deerhaven fossil fuel-fired generating station, near Gainesville, Florida, has achieved zero waste discharge by reusing cooling water treated by a front-end process. This uses a two-stage lime-soda softening process. In the first stage lime is used to precipitate bicarbonate alkalinity, Mg, and silica at a pH of 11.2-11.4. In the second stage soda ash and carbon dioxide are added to remove Ca and remaining silica. Sludge is treated with potato starch and polymer. The front-end method was chosen after a side-stream technique proved infeasible. During the first year of operation the average effluent contained 15 mg per liter Ca as CaCO3 and 2-3 mg per liter silica. This effluent quality allows 50 cycles of concentration and reuse. Liquid waste is treated in a vapor compression evaporator and spray dryer, and the residue is placed in a clay-lined landfill. The zero discharge policy has decreased the quantity of groundwater taken from the Floridan Aquifer and has reduced damage to the environment downstream of the former waste discharge. (Cassar-FRC)
W84-00386

WATER REUSE AND RECYCLING IN THE FOOD PROCESSING INDUSTRY,
Montgomery (James M.), Inc., Walnut Creek, CA.
L. L. Russell, K. H. Conarroe, C. F. Creson, J. Keller, and L. Esvelt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125137, Price codes: A15 in paper copy, A01 in microfiche. Technical Report RU-82/13, July 1983. 345 p, 40 Fig, 55 Tab, 126 Ref, 6 Append. OWRT C-90180-R (No 9416)(1), 14-34-0001-9416.

Descriptors: *Food processing industry, *Food-processing wastes, *Industrial wastewater, Indus-

trial water, Reclaimed water, Wastewater renovation, Process water, Recirculated water, Water use, *Water reuse, Wastewater, Health effects.

The potential for water reuse and recycle in each of the major water-using segments of the food industry was evaluated, and projections made for the 1985 and 2000 year water withdrawals in each of the segments with the implementation of water reuse and recycle. The geographic potential for water reuse and recycle was determined in each of the Water Resource Council subregions by past water withdrawals for food processing water availability and types of food processing within the subregion. Product contamination and its impact on the health of the consumer are the major concern in water reuse and recycle in food processing. The potential for reducing product contamination discussed in the report involves the development of water quality criteria for water reuse and recycle in food processing and the evaluation of suitable products and processing operations which will eliminate or reduce contamination resulting from water reuse and recycle prior to final processing operations.
W84-00446

WATER MANAGEMENT INITIATIVES IN THE COMMONWEALTH,
For primary bibliographic entry see Field 3D.
W84-00483

3F. Conservation In Agriculture

CROP YIELD AS AFFECTED BY SPATIAL VARIATIONS OF SOIL AND IRRIGATION,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. W. Warrick, and W. R. Gardner.
Water Resources Research, Vol 19, No 1, p 181-186, February, 1983. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Crop yield, *Irrigation, *Soil properties, Spatial variation, Monte Carlo method, Costs.

Crop yield is calculated for varying uniformities of seasonal available water. The variation is a consequence of both irrigation and soil heterogeneity. Analytical expressions and Monte Carlo simulations are used to calculate yields for an assumed linear response function. A comprehensive table from the Monte Carlo simulations includes results for 50, 100, and 200% of the water necessary for maximum yield. These are collated with five uniformities and three levels of effective available water. Uniformities of water are expressed as coefficients of variation ranging from 0 to 2. Variations in either irrigation or soil uniformity change the results, but irrigation uniformity is likely the more important, especially for surface systems. The effect of taking the two distributions--for irrigation and soil-- to be correlated does not affect results greatly. When only cost of water is considered, the marginal rate of return is verified to be a maximum for smaller operations. (Author abstract)
W84-00402

BURIED TREASURES OF THE HIGH PLAINS,
Camp, Dresser and McKee, Inc., Austin, TX.
For primary bibliographic entry see Field 4B.
W84-00482

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

SMALL HYDRO MAY HELP CZECHOSLOVAKIA'S NEEDS,
International Water Power and Dam Construction, Vol 35, No 2, p 45-56, February, 1983.

Descriptors: *Powerplants, *Hydroelectric power, *Water resources development, *Planning, Czechoslovakia, Energy, Economic aspects, Water demand.

A survey conducted by the Czechoslovak Ministry of Energy has determined that 11 TWh could be generated if all the feasible small scale hydro sites were to be exploited in the country. However, the planning difficulties of constructing and equipping these stations may prove to be too large. Currently small-scale hydro stations provide 3.7 GWh of energy every year to the Czechoslovakian economy, accounting for about 5% of all the country's hydropower output. The basic principles of long-term mini-hydro development were approved by the government in 1979, and practical strategies have since been detailed in a number of government decrees, calling on local councils to investigate the options of water power resources within the area, with particular reference to locations where existing dams, reservoirs and weirs favor the installation of mini-hydro equipment. Credit terms made available are highly favorable for new developments. Even so, little has been done so far. Many local councils feel that the yield of mini hydro stations is so modest, and the profit so small, that it is not worth their while to invest time or capital on the sites. Others are wary of the duties involved. The most important deterrent is that there are no standard ranges of turbine or generator units readily available on the Czechoslovak market. The units now operating are invariably one-off designs which require the attention of a local enthusiast to continue functioning. (Baker-FRC)
W84-00410

HYDROPOWER PROSPECTS FOR SPAIN,
International Water Power and Dam Construction, Vol 35, No 2, February, p 24-27, 1983. 4 Fig, 3 Tab.

Descriptors: *Hydroelectric power, *Water resources development, *Dam construction, *Planning, Spain, Floods, Drought.

The first socialist government in Spain for more than 40 years is making plans to accelerate its water control and hydropower program and strengthen the plans it inherited from the previous leadership to extend irrigated areas and invest more capital in dam building. A greater use of water resources and a substantial increase in Spain's new Plain Hidrologico Nacional covering the period between 1982 and 1986 are part of the plan. The drought over the past 3 years indicated severe need for water reserve development in the southern part of the country. The most urgent sections of the current plan deal with the south of Spain, the Guadalquivir river basin, and area of the Guadina river. The general outline of the plan is that Spanish territories should yield another 14,000 cubic meters/year of water to be regulated, which would mean that some 60% of the natural water resources would be controlled. Dam reservoir capacity would have to be raised from the present 46065 cubic hm to 76000 cubic hm. Much work is needed in the mountainous areas of the Iberian Peninsula to ensure that drought conditions can be withstood, and to limit the flash floods, which caused worse damage in the Pyrenees than the Valencia region. (Baker-FRC)
W84-00411

THE HYDRO POTENTIAL OF AUSTRIA,
Oesterreichische Elektrizitaetswirtschafts A.G., Vienna.
A. Gotz, and G. Schiller.
International Water Power and Dam Construction, Vol 35, No 2, February, p 27-30, 1983. 1 Fig, 5 Tab.

Descriptors: *Hydroelectric power, *Water resources development, Austria, Water management, Powerplants, Planning.

Definitions and limitations of surveys of the hydropower potential of Austria are reviewed. The various contrasting characteristics of run-of-river and reservoir-based plants are described. Streams with an annual mean water flow of less than 1 cubic meter/sec were disregarded in the survey. Currently 52% of the exploitable energy p
already being used, 8% is still being deve
40% is still only planned. The Danube
area represents by far the greatest po
21,685 GWh/year. The Danube alone ha
tial of 15,539 GWh/year of which 75%
either being produced or being worked
total exploitable potential is viewed
GWh/year. The extent of current expl
highest in the Upper Austria area as
rivers have already been exploited su
Danube, the Inn and the Ems, and the
under development. After this come Lo
tria and Vorarlberg at 68%, Tyrol 44%
Steiermark at 41%. To achieve the max
velopment/potential, large sections of the
water network would remain free of en
duction developments. (Baker-FRC)
W84-00412

**DISCUSSION: 'OPTIMAL RESERVOI
AGEMENT AND CROP PLANNING
DETERMINISTIC AND STOCHAST
FLOWS,' BY C. C. MAJI AND E. O.**
California Univ., Davis. Dept. of Civil
ing.
S. Arora, and O. Helweg.
Water Resources Bulletin, Vol 17, No 3, p
June, 1981.

Descriptors: *Reservoir operation, *
Linear programming, Model studies, Crop
tion.

The above titled paper, published in W
sources Bulletin, Vol 16, No 3, p 438-4
uses linear programming to solve water
problems. The authors of this comment
several difficulties arising from the pres
(1) the variable, A sub ijt, having the dim
acres, is not properly defined and should b
sionless, (2) the value of Indian currency
given the proper value when the model i
to future years by using an appropriate
rate, (3) suggested water storage figures
from the model solution are less than t
demand, and (4) post-optimal analyses, co
sensitivity analysis and parametric progr
of optimal solutions was omitted. (Cass
W84-00526

**LOW-FLOW CHARACTERISTICS
STREAMS IN THE LAKE MICHIGAN
WISCONSIN,**
Geological Survey, Madison, WI. Wa
sources Div.
For primary bibliographic entry see Field 2
W84-00546

**A COMMENTARY ON COLUMBIA RIV
STREAM FLOWS,**
Washington State Univ., Pullman. Dept.
and Environmental Engineering.
H. D. Copp.
Available from the National Technical Info
Service, Springfield, VA 22161 as PB84-
Price codes: A03 in paper copy, A01 in mic
Water Research Center Completion
August 1983. 21 p, 8 Fig, 2 Tab, 10 Ref. OW
113-WASH(1), 14-34-0001-2151.

Descriptors: *Columbia River, Fisheries, *
power, Instream flow, *Water management
ulated flow.

The Washington State Department of Eco
1980 adopted the Columbia River Instre
source Protection Plan (CRIRPP). This p
quires that flowrates in the river be at
minimum specified levels (or higher) at al
Columbia River flowrates are highly regul
storage and hydropower plants. Plant di
fluctuates accordingly to fairly-well esta
power demands, particularly in low wate
CRIRPP requires that streamflow reg
would need to be modified so that outflow
plants are higher than at present. In tu
means that power demand patterns would
be modified, significant spill would be nec
or some of both. There appears to be su

, even in low runoff years, specifically, to CRIRPP requirements at Columbia River ons upstream from the Snake River conflu- The Pacific Northwest Power Planning Act 6-501) likely will impact Columbia River management even more dramatically than PP. An analysis of these impacts is beyond ope of the study reported here; however, a iscussion is included.
0641

Groundwater Management

-TERM VARIATIONS OF GROUND- ER RESOURCES OF THE NORTHERN SPHERE,
imary bibliographic entry see Field 2F.
0380

ARGE FROM AN EPHEMERAL AM FOLLOWING WETTING FRONT AR- L TO WATER TABLE,
ry of Agriculture and Water, Riyadh (Saudi).
imary bibliographic entry see Field 2F.
0390

-TERM IMPACTS OF SURFACE NG ON GROUND WATER IN TEXAS A PLAIN LIGNITE MINES,
imary bibliographic entry see Field 5B.
0421

ED TREASURES OF THE HIGH PLAINS,
Dresser and McKee, Inc., Austin, TX.
Villiams.
/Engineering and Management, Vol 130, No -27, March, 1983. 1 Tab.

ptors: *Groundwater management, *Water ge, *Agriculture, Water conservation, Ogal- uifer, Irrigation, Aquifers, Groundwater de- , Water management, *High Plains Region, States.

epartment of Commerce study on the Ogal- quifer predicted that groundwater depletion reduce the total irrigated acreage by 5.1 acres, or 1/3 of the total 1977 acreage, by The regional economy is not expected to as much as was initially predicted because of conservation practices and a shift to crops ng less water (cotton and wheat). Water es are expected to drop (from 1977 to 2020) % in Colorado, 25% in Kansas, 16% in ska, 60% in New Mexico, 52% in Oklahoma, % in Texas. (Cassar-FRC)
0482

LOPING AND MONITORING MUNICI- GROUNDWATER SUPPLIES IN FLOR-

Coast Regional Water Supply Authority, vater, FL.
rimary bibliographic entry see Field 6D.
0573

NDWATER USE MANAGEMENT IN NORTHEASTERN STATES--LEGAL AND TUTIONAL ISSUES.
imary bibliographic entry see Field 6E.
0594

ND WATER RESOURCES OF THE GLA- OUTWASH ALONG THE WHITE RIVER, SON AND MORGAN COUNTIES, INDI-

gical Survey, Indianapolis, IN. Water Re- s Div.
Bailey and T. E. Imbrigiotta.
Water-Resources Investigations 82-4016, 1982. 87 p, 27 Fig, 10 Tab, 41 Ref.

iptors: *Aquifer characteristics, Geohydrolo- oundaries, Geohydrology, Glacial drift, Ground-water movement, Groundwater potential, Groundwater recharge, *Hydrologic models, *Indiana, Iron, Losing streams, Manganese, Observation well, Organic carbon, *Outwash, Seasonal variation, Surface-groundwater relations, Unconfined aquifers, Water-quality standards, *Groundwater model, *Groundwater quality, Johnson County, Morgan County, Water quality assessment, White River.

An 88-square-mile segment of the White River valley contains an unconfined sand and gravel aquifer ranging-from a featheredge zero, to 120 feet in saturated thickness. Hydraulic conductivity is 340 feet per day, and transmissivity is as much as 35,000 square feet per day. The aquifer, recharged primarily by precipitation, gains same recharge through interbedded till and outwash boundaries and through losing streams. A two-dimensional digital model was used to simulate the steady-state ground-water flow system. Sensitivity analyses tested the reaction of the model to adjustments in hydraulic conductivity, steam bed leakance, and recharge. Simulated pumpage of 20-, 66-, and 122-million gallons per day reduced streamflow by 5, 15, and 30%, respectively. A real drawdown did not exceed 25 feet. Ground water was a calcium bicarbonate type having a median pH of 7.1, a mean alkalinity of 240 milligrams per liter, a mean hardness of 280 milligrams per liter, a mean dissolved oxygen concentration of 2.2 milligrams per liter, a mean redox potential of +347 millivolts, and a mean dissolved-solids concentration of 366 milligrams per liter. Iron and manganese concentrations exceeded National Drinking Water Regulations in 15 and 49% of the analyses, respectively. Temperature and concentration of dissolved organic carbon varied seasonally. Dissolved carbon and manganese varied with seasonally. Dissolved carbon and manganese varied with differing boundary material, till and bedrock. (USGS)
W84-00609

PRELIMINARY EVALUATION OF THE POTENTIAL FOR ARTIFICIAL GROUNDWATER RECHARGE IN EASTERN SAN JOAQUIN COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
H. T. Mitten.
USGS Open-File Report 82-123, July 1982. 31 p, 13 Fig, 2 Tab, 19 Ref.

Descriptors: *Artificial recharge, *Groundwater recharge, Recharge, *California, San Joaquin Valley, Central Valley, San Joaquin County.

In response to increasing demand on water supplies and declining water levels in San Joaquin County, the U. S. Geological Survey, in cooperation with the San Joaquin County Flood Control and Water Conservation District, is evaluating the potential for artificially recharging the aquifer system in eastern San Joaquin County, California. Through a well canvass and analyses of existing data on geology, soils, and drillers logs, this study (phase one of three phases) resulted in identification of 20 sites for exploratory test drilling in areas potentially favorable for artificial recharge. Ten of the sites are in areas adjacent to the Mokelumne River, six are in areas adjacent to the Calaveras River and Mormon Slough, and four are north of Littlejohns Creek. (USGS)
W84-00645

SIMULATIONS OF FLOW IN A GLACIAL OUTWASH AQUIFER, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
A. C. Razem.
USGS Water-Resources Investigations Report 83-4022, 1983. 32 p, 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Computer models, Aquifer characteristics, *Glacial aquifers, Pumping, Groundwater recharge, Surface-groundwater relations, *Drawdown, *Ohio, *Columbus, Middle Scioto River Valley.

A two-dimensional, finite-difference model is used to simulate transient flow conditions in a glacial outwash aquifer in southern Franklin County, Ohio. The model was calibrated by matching observed and simulated water-level changes for December 1977 through March 1980. Drawdowns for three different hypothetical pumping rates are simulated with the calibrated flow model. An increase in the pumping rate from the steady-state rate of 10 cubic feet per second to 48 cubic feet per second results in water-level declines of 10 to 20 feet near the area of the pumping wells. Declines of 20 to 40 feet result when the pumping rate is increased to 70 cubic feet per second, and a simulated pumping well goes dry when the combined pumping is increased to 94 cubic feet per second. For the first two cases, steady-flow conditions are reached after 12 years of pumping; infiltration through riverbeds accounts for 28 to 33% of the pumpage.
W84-00656

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF UNDERGROUND MINING AND MINE COLLAPSE ON THE HYDROLOGY OF SELECTED BASINS IN WEST VIRGINIA,
West Virginia Geological and Economic Survey, Morgantown.
For primary bibliographic entry see Field 2F.
W84-00547

HYDROLOGIC DATA FOR URBAN STUDIES IN THE HOUSTON, TEXAS, METROPOLITAN AREA, 1979,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00602

HYDROLOGIC DATA FOR URBAN STUDIES IN THE DALLAS, TEXAS, METROPOLITAN AREA, 1979,
Geological Survey, Fort Worth, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00603

EFFECTS OF SANITARY SEWERS ON GROUND-WATER LEVELS AND STREAMS, NASSAU AND SUFFOLK COUNTIES, NEW YORK--PART I: GEOHYDROLOGY, MODELING STRATEGY, AND REGIONAL EVALUATION,
Geological Survey, Syosset, NY. Water Resources Div.
T. E. Reilly, H. T. Buxton, O. L. Franke, and R. L. Wait.
USGS Water-Resources Investigations 82-4045, 1983. 45 p, 12 Fig, 6 Tab, 48 Ref.

Descriptors: *Groundwater, Model studies, Surface groundwater relationships, *Sewers, Simulation, *Computer models, Long Island, *New York.

A computer simulation of Long Island's regional groundwater system has been used to evaluate the effects that new-installed sewers will have on ground-water levels. Results indicate maximum water-table decliners of as much as up to 18 feet in central Nassau County and about 9 feet in Suffolk County. Total stream base flows and freshwater outflow to the south shore bay system will decrease by 22%. The regional scale of the model does not permit detailed predictions for individual streams. To quantify the effects of lowered ground-water levels on individual streams, two fine-scale sub-regional models have been designed. This report, the first in a three-part series describing the simulated effects of sewers in southern Nassau and southwestern Suffolk Counties, presents the hydrogeologic setting, pertinent literature, modeling strategy, subregional model design, and the results obtained to date from the regional ground-water model. The regional model results described will be used in the later reports to generate flux boundary conditions for the subregional models. (USGS)
W84-00679

4D. Watershed Protection

TO REMEDY EROSION: CONTOUR SPREADER-SEEPAGE FURROWS,
J. Hindson.
Environmental Conservation, Vol 9, No 3, p 251, 1982.

Descriptors: *Erosion control, *Storm runoff, Groundwater supplies, Groundwater development, Erosion, Contour spreader-seepage furrows, Contour terracing, Contours.

The use of contour spreader-seepage furrows to control the flow of storm water down a slope is described. A cut is made in the earthen slope, thus allowing a place for the storm water to collect. This cut is spread along the top of the slope, allowing the collected water to likewise spread out for 100-200 meters before being sent over the edge of the cut and on down the slope. The soil taken from the slope to make the cut is spread on top of the slope on the downhill side, where the water will eventually begin to trickle over the edge. The spreading effect on concentrated storm-water runoff is probably the largest single benefit of the contour spreader-seepage furrow program. The other major benefit is the water storage and infiltration aspect of the work. The groundwater (water table) will inevitably benefit very considerably, especially in deep absorbent soils. This means that erstwhile springs could begin to flow again and wells and water holes would not dry up. In areas needing improved groundwater supplies, CSFs may provide the answer so long as there is periodic surface storm water runoff which would otherwise run to waste. (Baker-FRC)
W84-00358

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

A SIMPLE FIELD TEST FOR THE DETECTION OF FAECAL POLLUTION IN DRINKING WATER,
Defence Research and Development Establishment, Gwalior (India). Div. of Microbiology.
K. S. Manja, M. S. Maurya, and K. M. Rao.
Bulletin of the World Health Organization, Vol 60, No 5, p 797-801, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Water analysis, *Water quality control, *Feces, Drinking water, Pollutant identification, Coliforms, Hydrogen sulfide, Human disease, Hepatitis.

A very simple method is presented for assessment of contamination in drinking water based on the detection of hydrogen sulfide-producing organisms. This new test was found to be reliable, simple to perform, and required few facilities. The concentrated medium used in the test contained 20 g of peptone, 1.5 g of dipotassium hydrogen phosphate, 0.75 g of ferris ammonium citrate, 1 g of sodium thiosulfate, 1 ml of Teepol, and 50 ml of water. Aliquots of 1 ml of the concentrated medium were absorbed onto folded tissue paper which was placed in a McCartney bottle, sterilized, and dried at 50C under sterile conditions. The water samples to be screened for faecal pollution were placed in the bottles, up to a pre-calibrated mark (20 ml) and allowed to stand at ambient temperature (30-37C). Fecal pollution is indicated if the contents of the bottle turn black within 12-18 hours, in which case the water was graded as unfit for consumption. This test should be useful for screening rural water supplies and for large-scale screening of urban water supplies where resources, time, manpower, and laboratory facilities are limited. (Baker-FRC)
W84-00364

LONG-TERM STUDY OF VIRUS CONTAMINATION OF SURFACE WATER IN THE GERMAN DEMOCRATIC REPUBLIC,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
R. Walter, H. -J. Dobberkau, W. Bartelt, W. Diener, and I. Hartel.
Bulletin of the World Health Organization, Vol 60, No 5, p 789-795, 1982. 4 Fig, 1 Tab, 17 Ref

Descriptors: *Surface waters, *Viruses, *Public health, Germany, Berlin, Human disease, Pollutant identification, Water quality, Drinking water, Water treatment, Disinfection, Enteroviruses, Coxsackie virus.

From 1970 to 1979 a total of 1908 surface water samples from 30 sampling points were evaluated for determination of the concentration of viruses. The rate of virus isolation ranged from 8 to 92%, with a mean of 20%. There were considerable differences in isolation rate among the sampling points, and the rate for any particular point varied from year to year. The mean value of virus concentration was 2.7 cytopathogenic units per liter, while the maximum was 22.1 CU/liter. Viruses seen during the 10 year period included poliovirus types 1, 2, and 3, echovirus types 6, 11, and 30, and coxsackievirus B 3 and B 5; echovirus 7 and 24, coxsackievirus B 1, and adenovirus 5 were seen occasionally. The findings reflected the high level of use of surface waters in the German Democratic Republic. Where water is intended for human use such as drinking or recreation, reasonable safety measures such as water treatment and disinfection should be taken to ensure that the level of viral contamination is within the permissible limits. (Baker-FRC)
W84-00365

RADIUM-224 IN NATURAL WATERS MEASURED BY GAMMA-RAY SPECTROMETRY,
Chevron USA, Inc., New Orleans, LA.
R. J. Eisinger, P. T. King, and W. S. Moore.
Analytica Chimica Acta, Vol 144, p 277-281, 1982. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Pollutant identification, *Radon, *Isotopic tracers, *Spectrophotometry, Radioisotopes, Isotope studies, Estuaries, Separation techniques, Groundwater, Fate of pollutants.

A method based on germanium (lithium) gamma-ray spectrometry was applied to the determination of radon 224 in natural waters. The radon radioisotope is removed from several hundred liters of water by preconcentration onto manganese dioxide-impregnated acrylic fibers. The acrylic fibers are leached with water, and the radium is coprecipitated with barium sulfate. The gamma-ray activity is counted so that the activity ratios among the 224, 226, and 228 radon isotopes can be determined. Concentrations are calculated by using the radon 226 concentration determined on a small separate sample. The method was applied to the determination of radon in groundwater and estuarine and continental shelf waters. (Geiger-FRC)
W84-00372

PRESENCE OF ASBETOS FIBERS IN DRINKING WATER IN THE FEDERAL REPUBLIC OF GERMANY AND HEALTH EVALUATION OF THE RESULTS (UNTERSUCHUNGEN ZUM VORKOMMEN VON ASBESTFASERN IN TRINKWASSER IN DER BUNDESREPUBLIK DEUTSCHLAND UND GESUNDHEITLICHE BEWERTUNG DER ERGEBNISSE),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
E. Meyer.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 2, p 85-96, February, 1982. 9 Fig, 5 Tab, 35 Ref.

Descriptors: *Asbestos, *Drinking water, Water pollution sources, Pipes, Chemical reactions, Analysis public health.

The results of a preliminary study on the presence of asbestos fibers in drinking water are presented. Measurements were performed by filtering water samples (generally 0.5 liter) through a 0.45 micron cellulose acetate membrane filter, ashing the filter and the residue, suspending the residue in water, and again filtering on a polypolycarbona
The filters are applied to a carbon sample
and a silver layer is vapor-deposited
sample. The prepared samples are read in
ning electron microscope with an electr
microanalysis attachment. The possibilities
fusion of asbestos fibers with particles
mineral fibers present in water are reduc
this method. The results of the study show
some cases asbestos-like fibers of natural o
contained in surface and ground waters
of water samples taken after the water ha
through asbestos pipes demonstrated that
lease of asbestos fibers is determined by the
cal qualities of the water. When the water
through the pipes is almost saturated with
carbonate, there is no release of asbestos fi
outline of the present state of the art with
to the evaluation of the health effects of
fibers ingested with drinking water is also
ed. (Carroll-FRC)
W84-00374

**DETERMINATION OF THE COMPO
OF WASTE WATER FORM BIS (2-E
HEXYL) PEROXYDICARBONATE PR
TION BY GAS-SOLID CHROMATOGR
(BESTIMMUNG DER ZUSAMMENSET
DES ABWASSERS AUS DER BIS(2-ET
HEXYL) PEROXYDICARBONATE-PR
TION MIT HILFE DER GAS-ADSORPT
CHROMATOGRAPHIE),**
Instytut Ciezkiej Syntezy Organicznej Bl
nia, Kedzierzyn Kozle (Poland).
P. Kusz, E. Pisarzewska, A. Andrysiak, and
Kwasnicki.
Fresenius Zeitschrift fuer Analytische Chem
313, No 1, p 44-45, 1982. 1 Fig, 1 Tab,

Descriptors: *Water analysis, *Chromatog
*Industrial wastes, *Peroxydicarbonates, Po
ization, Pollutant identification.

Organic peroxydicarbonates are active initia
radial polymerization of various compound
as vinyl chloride, ethylene, vinylidene chlori
others. Usually these peroxydicarbonates a
duced in a two-stage process, the first stage
ing phosgenation of the related alcohol a
second stage being oxidation of the ester pr
to give the dialkyl peroxydicarbonate. A me
presented for the determination of the comp
of waste water arising from washing of the p
after the second stage is completed. For the
sis a gas chromatograph equipped with a t
conductivity detector is employed. The c
temperature is programmed in a range of
degrees C with an increment of 12 degrees
min. The temperature of the injector and de
was 250 degrees C. Helium microliters were
ed by means of a S.G.E. microsyringe of 5
liter capacity. This procedure allowed sepa
of all components of wastewater from
ethylhexyl)peroxidicarbonate production. O
2-ethylhexanol-1 and 2-ethylhexyl chlorofo
as 2-ethylhexyl chloroformate as 2-ethy
chloroformate oxidation products were deter
in waste water using standards. In order to
late each content n-propanol was used as in
standard. (Baker-FRC)
W84-00422

**DIRECT AND SIMULTANEOUS STRIP
VOLTAMMETRIC DETERMINATION
ZINC, CADMIUM, LEAD, THALLIUM,
COPPER IN ENVIRONMENTAL WATE
THE PRESENCE OF HUMIC ACIDS (IN
VOLTAMMETRISCHE DIREKTE UND
MULTANE BESTIMMUNG VON ZINK,
MIUM, BLEI, THALLIUM UND KUPFE
NATURLICHEN WASSERN IN GEGENW
VON HUMINSAUREN),**
Muenster Univ. (Germany, F.R.). Anorga
Chemisches Inst.
F. Schlieckmann, and F. Umland.
Fresenius' Zeitschrift fuer Analytische Ch
Vol 314, No 1, p 21-24, 1983. 4 Fig, 1 Tab,

Descriptors: *Chemical analysis, *Heavy m
*Humic acids, *Pollutant identification,
Copper, Thallium, Zinc, Cadmium. N
waters.

method is described which enables the
nd simultaneous determination of zinc, cad-
lead, thallium, and copper in humic acid
ing waters without separation from the or-
naterial. The anodic-stripping voltammetric
(ASV) is used in a potassium hydroxide
/carbonate electrolyte. The supporting
yte is 0.1 N in KOH and 0.04 M in citrate
djusted with carbon dioxide gas to pH 10 to
itrate suppresses the precipitation of carbon-
pecially calcium carbonate. Zinc is record-
direct current ASV. The current is then
d over to alternating current ASV for re-
the other elements. A linear concentration
ence of all elements has been found down
parts per billion in the presence of humic
Author's abstract)
0423

**; AND BASES IN FRESH-WATERS, IN-
RETATION OF RESULTS FROM GRAN
s,**
niv. (Norway). Inst. for Kjemi.
lvaersmyr, and W. Lund.
Research, Vol 17, No 3, p 303-307, March,
Fig, 3 Tab, 7 Ref.

ptors: *Acids, *Bases, *Water analysis,
ant identification, *Gran plots, Hydrogen
ncentration, Titration.

ms with Gran plot analysis of strong and
cids in natural water samples are discussed.
is of synthetic samples prepared from
bicarbonate and sodium acetate produced
e values for the strong acid, indicating that
Cl added prior to each titration was con-
by the bases. A corresponding positive
was obtained for weak acids, showing that
es were not volatilized upon acidification.
H range of titration is important for reliable
Incorrect results were obtained for the
n range 4.1-9.6, although this range on the
lot had straight line regions at 4.1-4.3 and
Reliable results were obtained in the pH
3.6-10.3, obtained by adding more HCl at the
f the titration. This range should cover both
s containing acids with low pKa values (re-
low starting pH) and high pKa values (re-
high end pH). (Cassar-FRC)
0443

**RT OF 1981 ORGANIC CHEMICAL SUR-
LANCE SURVEY AT COMMUNITY
R SYSTEMS IN NEW YORK STATE,**
York State Dept. of Health, Albany. Bureau
lic Water Supply Protection.
e, K. Slade, and K. Markussen.
1982. 9 p, 6 Append.

ptors: *Groundwater contamination,
ical wastes, *Contamination, *Organic com-
s, *Toxins, *Groundwater pollution, Water
, Water quality data, Water quality stand-
New York.

unity water systems, serving at least five
connections used by year-round residents or
rly serving at least 25 year-round residents,
surveyed by the Bureau of Public Water
Protection for organic chemical contami-
Samples representing a single source were
ed from 58 systems and samples represent-
ch of two sources were collected from 11
s for a total of 80 samples from 69 communi-
er systems. Organic chemicals were found in
round and surface sources of supply. Triha-
anes were detected in 29 of the 80 samples
represented 25 of the 69 community water
s sampled. Additional organic chemicals
letected in 28 of the 80 samples which repre-
26 of the 69 community water systems
d. Two water systems were found to have
cceptable level of organic chemicals present;
er, each system has discontinued using the
inated source and has actively pursued per-
t corrective action. Additional organic
al surveys are recommended along with on-
surveillance programs to detect these chemi-
Garrison-Omniplan)
0495

POTENTIAL HAZARDS OF NITRATE AND FLUORIDE IN UNDERGROUND WATER,
R.B.S. Coll., Bichpuri (India). Dept. of Agricultural Chemistry and Soil Science.
B. Pal.
Water Research, Vol 17, No 3, p 353-354, March, 1983. 2 Tab, 14 Ref.

Descriptors: *Nitrates, *Fluorides, *Water quality standards, Groundwater, Water analysis, Agra, *India, Saline water, Conductivity, Drinking water, Irrigation water, Pollutant identification.

A series of 113 groundwater samples collected from wells in the semiarid tract of Agra, India, contained up to 148.8 mg per liter nitrate and up to 18.5 mg per liter fluoride. Nitrate and fluoride levels increased with increasing conductivity from an average of 18.1 mg per liter nitrate and 0.6 mg per liter fluoride at 1-2 mmhos per cm to an average of 100.6 mg per liter nitrate and 10.1 mg per liter fluoride at >15 mmhos per cm. Fluoride levels exceeded 1 mg per liter (drinking water standard) in 49% of samples and exceeded 10 mg per liter (safe limit for crops) in 23.1% of samples. Nitrate levels exceeded the 10 mg per liter standard for drinking water in 86.6% of samples and exceeded 45 mg per liter (International Standards for Drinking Water) in 40% of samples. (Cassar-FRC)
W84-00528

IRRIGATION-WATER QUALITY IN THE SULPHUR CREEK BASIN, YAKIMA AND BENTON COUNTIES, WASHINGTON, APRIL 1976 THROUGH MARCH 1977,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W84-00541

SURFACE-WATER QUALITY DATA FROM SELECTED SITES IN WASHINGTON AFFECTED BY MOUNT ST. HELENS ERUPTIONS: MARCH 27 - SEPTEMBER 30, 1980,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00542

DETERMINATION OF TRIAZINES IN WATER BY GC AND LC,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Dept. of Analytical Chemistry.
M. Popl, Z. Voznakova, and V. Tatar.
Journal of Chromatographic Science, Vol 21, No 1, p 39-42, 1983. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Pollutant identification, *Herbicides, *Gas-liquid chromatography, *Triazine pesticides, *Sorption, Pesticides, Separation techniques, Chromatography, Gas chromatography, Water analysis.

A new method was formulated for the chromatographic determination of trace amounts of s-triazine-type herbicides in water. Model water samples were prepared by introducing a volume of the triazine standard in methanol, at concentrations ranging from 200 to 4000 ppm, into 50 milliliters of distilled water. After preconcentration by sorption on a macroporous polymer sorbent and desorption with acetone, s-triazines are determined in the desorbate by gas or liquid chromatography. The s-triazines in water may be detected at the 0.1 ppb level by use of gas-liquid chromatography with a nitrogen-phosphorus detector, or at the ppb level by liquid chromatography with an ultraviolet detector. Recovery from the preconcentration step is virtually complete and analysis takes no more than 1.5 hr. (Geiger-FRC)
W84-00567

STANDARD PLATE COUNT: A COMPARISON OF POUR PLATE AND SPREAD PLATE METHODS,
California Water Service Co., San Jose.
R. H. Taylor, M. J. Allen, and E. E. Geldreich.
Journal of the American Water Works Association, Vol 75, No 1, p 35-37, January, 1983. 1 Fig, 4 Tab, 20 Ref.

Descriptors: *Pollutant identification, *Heterotrophic bacteria, *Bacterial analysis, *Culturing techniques, Aquatic bacteria, Water analysis, Statistical methods, Bacteria.

Evidence from the literature is presented which shows that the standard pour plate procedure recovers only a very low percentage of the total bacterial population present in a water sample. In a long-term study involving routine sampling of dead-end water mains in the Cincinnati, Ohio distribution system, the spread plate and pour plate procedures of bacterial recovery were compared. Of the 613 samples collected, 571 yielded acceptable bacterial counts by both methods. Statistical analysis of test efficiency showed that the spread plate procedure was more precise and more accurate than the pour plate procedure for enumerating heterotrophic plate count population. The spread plate counts consistently decreased as chlorine levels increased, whereas pour plate results were not as consistent through the entire range of free chlorine residuals. While both the spread plate and pour plate procedures offer distinct advantages over the current standard method, analysts must continue to do comparative, parallel testing until they are included in a future edition of Standard Methods. (Geiger-FRC)
W84-00574

QUALITY-OF-WATER DATA AND STATISTICAL SUMMARY FOR SELECTED COAL-MINED STRIP PITS IN CRAWFORD AND CHEROKEE COUNTIES, SOUTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00650

TRACE ELEMENT ANALYSIS OF GROUNDWATER: COMPARISON OF PROTON-INDUCED X-RAY EMISSION (PIXE) WITH ATOMIC ABSORPTION ANALYSIS (AA),
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemistry.
G. S. Hall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136795, Price codes: A03 in paper copy, A01 in microfiche. Center for Coastal and Environmental Studies Completion Report, July 1983. 22 p, 5 Fig, 3 Tab, 13 Ref. OWRT A-064-NJ(1), 14-34-0001-1132.

Descriptors: Heavy metals, *Groundwater pollution, Chelating agents, X-rays, *Trace elements, *Atomic absorption spectroscopy, *Proton-induced x-ray emission(PIXE).

A simple, rapid, sensitive, accurate, and multielemental analytical method was developed for trace element analysis of groundwater. The method incorporated preconcentration of the water sample with sodium dibenzyldithiocarbamate (NaDBDTC) and was followed by quantitative analysis using external beam proton-induced X-ray emission (PIXE). The emphasis was on quantitative analysis of the elements on the EPA priority pollutant list that included Sb, Cu, Se, Ag, Th, Ni, Zn, Pb, As, Cd, and Hg. The method is particularly attractive for PIXE analysis because akali, akaline, and halogen elements were not complexed. The detection limits for the method were in the 50-60 parts per trillion range using a 6 minute proton irradiation. PIXE was compared with atomic absorption in terms of cost, sensitivity, accuracy, speed of analysis, and precision. It was found that the PIXE method was superior in all cases except for accuracy, in which the method was accurate within 10%.
W84-00685

5B. Sources Of Pollution

DISSIPATION OF MASSIVE QUANTITIES OF 2,4-D AND 2,4,5-T N-BUTYL ESTERS IN FIELD MINI-LYSIMETERS,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
J. T. Majka, H. H. Cheng, and T. J. Muzik.

Journal of Environmental Quality, Vol 11, No 4, p 645-649, October-December, 1982. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Herbicides, *Waste disposal, *Chemical wastes, Degradation, Fate of pollutants, Industrial wastes, 2,4-D, 2,4,5-T, Revegetation, Infiltration.

The fate of large quantities of the herbicides 2,4-D and 2,4,5-T n-butyl esters on three soils was studied from December 1976 to April 1979 in minilysimeters located in Pullman, Washington. The esters were applied in a 1:1 mixture at the rates of 560 or 2800 kg per ha to simulate an accidental spill from damaged drums or from disposal of industrial wastes. Soils were: Washington silt loam with pH 5.5, Wyoming clay loam with pH 7.6, and Mississippi sandy loam with pH 4.7. At the lower application rate, both esters dissipated to <1% of the initial concentration in the surface layer by the end of the experiment in the Washington and Wyoming soils; little dissipation of either ester took place in the Mississippi soil. At the higher application rate in all soils 2,4-D concentrations in the soil surface layer decreased slightly, and 2,4,5-T concentrations changed negligibly. Some downward migration of the herbicides from the surface layer to the 5-10 cm deep layer was evident. At the end of the experiment revegetation was noticeable only on the Washington and Wyoming soils at the lower application rate. (Cassar-FRC)
W84-00355

LABORATORY STUDY OF SULFURIC ACID SPILL CHARACTERISTICS PERTAINING TO MARITIME ACCIDENTS,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
I. N. Tang, W. T. Wong, H. R. Munkelwitz, and M. F. Flessner.
Environmental Science and Technology, Vol 16, No 9, p 587-593, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Water pollution sources, *Acids, *Accidents, Ships, Marine environment, Sulfuric acid.

Several acid-spill scenarios are briefly described; they were designed to simulate the two most important types of accidental acid spills reported. In the first type the convective mixing of concentrated sulfuric acid with water is shown to be governed by the buoyancy force arising from changes in acid concentration and released heat of dilution. In the second type, experiments with oleums have resulted in the formation of dense clouds of acid aerosols well within the respirable particle size range. The first type can be adequately described by a mathematical model, taking into account the variation of the buoyancy force arising from changes in acid concentration and liberated heat of dilution. A value of 0.21 is determined to be the entrainment parameter for the sulfuric acid-water system. For the second type a conservative estimate of less than 0.1% is obtained to represent the amount of airborne acid under most accident conditions. The fraction of airborne acid, however, decreases very rapidly with increasing release depth below the water surface. The acid aerosols exhibit a well-defined lognormal particle size distribution, with peak diameter varying from 0.1 to 0.6 micrometers depending upon release depths. Caution should be exercised when extrapolating these data to larger spills. (Baker-FRC)
W84-00359

SALMONELLA SPECIES AND SEROTYPES ISOLATED FROM FARM ANIMALS, ANIMAL FEED, SEWAGE, AND SLUDGE IN SAUDI ARABIA,
American Univ., Beirut (Lebanon). Dept. of Microbiology.
N. H. Nabbut, E. K. Barbour, and H. M. Al-Nakhli.
Bulletin of the World Health Organization, Vol 60, No 5, p 803-807, 1982. 2 Tab, 12 Ref.

Descriptors: *Salmonella, *Sludge, *Sewage bacteria, Land disposal, Saudi Arabia, Manure, Bacteria, Human disease, Public health, Epidemiology, Animal diseases

The isolations of salmonellae from farm animals, animal feed, sewage, and sludge in Saudi Arabia during 1977-1980 are reported. A total of 264 salmonellae representing 65 different species and serotypes were isolated for the first time in that country. The six most frequently isolated Salmonella species or serotypes were: livingstone, concord, 'S. schottmuelleri' (invalid), lille, S. typhimurium, and cerro. Of 61 samples of sewage, 37 were positive for Salmonella; 22 of 47 sludge samples were positive. The isolation of 30 different Salmonella species and serotypes from sewage and 11 from sludge indicates that sewage and sludge play a role in the dissemination of salmonellae in the environment and possibly to man and animals. This dissemination would be more significant if inadequately treated sewage effluents and sludges were used for the irrigation of crops or as soil conditioners. Sewage may be an important indirect source of salmonella infection in animals. Cases of salmonellosis in cattle may result from the application of sewage and cattle slurry to land, but it is difficult to tell how easily cattle grazing on contaminated pastures might become infected. (Baker-FRC)
W84-00363

RELEASE OF METHYL MERCURY FROM SEDIMENTS: EFFECTS OF MERCURY CONCENTRATION, LOW TEMPERATURE, AND NUTRIENT ADDITION,
Manitoba Univ., Winnipeg. Dept. of Microbiology
D. R. Wright, and R. D. Hamilton.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 11, p 1459-1466, 1982. 9 Fig, 38 Ref.

Descriptors: *Methylmercury, *Mercury, *Sediments, Lake sediments, River sediments, Microorganisms, Nutrients, Temperature effects, Biomethylation.

Methyl mercury release from unpolluted, mercury polluted, and mercury enriched lake and river sediments was studied using a flow-through system in plexiglass 'microbasins'. The release of methyl mercury as a function of time from Clay Lake and Wabigoon River mercury-laden sediments characteristically demonstrated a lag during the first week, an increase to a maximum at about 4 weeks followed by a decrease to a steady lower level related to mercury concentration. Production of methyl mercury ranged up to 3.3 micrograms/sq m/day increasing with increasing mercury content as if following saturation kinetics. It leveled off when mercury content was 15-20 micrograms Hg/g. An equilibrium between methylating and demethylating mechanisms is suggested. Release at 4C was 50-70% of that at 20 degrees, suggesting that in polluted Canadian lakes production in winter may be half the total for the year. Increased methyl mercury release was noted when tryptic soy broth was added to sediments at 0.06 to 0.25 g/cubic dm, and very marked increases when added to the water flow at 35 mg/l, suggesting an effect at the sediment-water interface. (Baker-FRC)
W84-00366

LEACHING CHARACTERISTICS OF LIGNITE ASH,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
M. J. Humenick, M. Lang, and K. F. Jackson.
Journal of the Water Pollution Control Federation, Vol 55, No 3:1, p 310-316, March, 1983. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Groundwater pollution, *Coal gasification, *Leaching, *Ash, Trace metals, Groundwater, Texas, Water pollution control, Sulfates, Calcium, Temperature effects, Aluminum, Arsenic, Boron, Phosphorus, Selenium, Silicon, Zinc.

Contaminants generated by water influx into burn cavities resulting from in situ coal gasification and the subsequent leaching of materials from residual ash are considered. The scope of work included a laboratory study of solubility effects, ash temperature, water temperature, lignite composition, and ash mineralogy. Lignite samples were obtained from three Texas sites. Ash content of the samples varied by more than a factor of three, whe mineral composition of ash varied with con temperature and source of lignite. The ma released to groundwater during leaching w cium and sulfate. Hydroxide seemed to be r in lesser quantities than when leaching as western coals. Leaching at 20C indicated and sulfate release to be proportional amount of these constituents in the ash, leaching at 80C exhibited no effect of ash co tion on calcium and sulfate release. Rel material at 80C was less than that at 20, inc that additional material can be released to g water over time as the surroundings coo release of sparingly soluble material is rea predicted by ionic equilibrium models. Of trace elements tested for in leachate sample aluminum, arsenic, boron, phosphorus, se silicon, and zinc were found in concent having some significance. Restoration of g water contaminated because of ash leaching achieved by withdrawal of cavity water. FRC)
W84-00383

OXYGEN DEMAND OF TACONITE INGS,
Texas Tech Univ., Lubbock. Dept. of Civi neering.
R. H. Plumb, and G. F. Lee.
Journal of the Water Pollution Control Fede Vol 55, No 3, p 317-322, March, 1983. 3 Tab, 18 Ref.

Descriptors: *Oxygen demand, *Mine *Lake sediments, Oxygen, Water pollution Taconite, Sediments, Lake Superior, Dis oxygen.

The possible oxygen demand of tailings de from a mining company into Lake Superi investigated. The disposal site was selected b of the deep, about 274 m, offshore trenc could accommodate the tailings discharge w a significant decrease in depth. The dischar found to exert a small, but definite demand oxygen of the lake sediments. Oxidation of f iron appeared to be the mechanism responsi the observed demand. A model was used t mate the oxygen concentration changes in Superior based on laboratory results. The o losses were estimated to be 0.3 mg/l at the s of the tailings deposit, which would decrea ponentially to 0 mg/l at 5 m above the d One field study indicated dissolved oxyge centration depletions of 0.1 to 0.2 mg/l abo tailings deposit. Other survey results sugge natural variation is greater than predicted o concentration changes from the discharge conite tailings. Taconite tailings have bee charged continuously since 1955, and DO co trations in the bottom waters of Lake Superi exceed 12 mg/l. It can therefore be conclude the discharge of taconite tailings is not hav significant impact on the dissolved oxygen co trations in the lake. (Baker-FRC)
W84-00384

EXPERIMENTAL INVESTIGATION ON I VERSIBLE CHANGES OF HYDRAULIC DUCTIVITY ON THE SEAWATER-FR WATER INTERFACE IN COA AQUIFERS,
Weizmann Inst. of Science, Rehovoth (I Dept. of Isotope Research.
For primary bibliographic entry see Field 2F.
W84-00403

MECHANISMS LEADING TO ENRICHM OF THE ATMOSPHERIC FLUOROCARB CCL3F AND CCL2F2 IN GROUNDWATER.
Arizona Univ., Tucson. Dept. of Hydrolog Water Resources.
A. D. Russell, and G. M. Thompson.
Water Resources Research, Vol 19, No 1, p February, 1983. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Fluorocarbons, *Ground dating, *Sorption, Fate of pollutants, Air poll Dating, Adsorption, Soil gases, Soil mo Water pollution sources, Industrial wastes.

uorocarbons CCl3F and CCl2F2 were deter-
in distilled water extracts of dry soil samples
sites in Arizona. Soil samples were assumed
tain fluorocarbons in equilibrium with the
here. Mean levels of CCl3F (ng per liter) in
pernatant water were 1.13-6.69; increases
ie control, 0.62, were 83-981%. Mean levels
12F2 (ng per liter) in the supernatant water
).51-1.29; increases over the control, 0.53,
rom -3.7 to 144%. Correlation between the
tage increase in fluorocarbons in the water
and organic matter content was very good
Cl3F and good for CC12F2. The probable
for the increase of fluorocarbons in water is
tion from soil surfaces due to competition
ater molecules for sorption sites. If soil air
tact with recharge water is also in contact
ie atmosphere through cracks and open pore
it may degas, reducing the concentration of
arbons in water reaching the aquifer. Con-
, infiltrating water with little contact with
nosphere would become enriched as it dis-
fluorocarbons from soil air with increased
pressures of these chemicals. These findings
plain some anomalies in groundwater dating
using the fluorocarbon method. (Cassar-

0406

**E-DIMENSIONAL STOCHASTIC ANAL-
OF MACRODISPERSION IN AQUIFERS,**
Mexico Inst. of Mining and Technology,
o.
Gelhar, and C. L. Axness.
Resources Research, Vol 19, No 1, p 161-
ebruary, 1983. 10 Fig, 3 Tab, 43 Ref.

ptors: *Anisotropy, *Stochastic hydrology,
e transport, Porous media, Aquifer proper-
lixing, Hydraulic conductivity, Convection,
studies, Groundwater movement.

spersive mixing resulting from complex flow
e-dimensional heterogeneous porous media
yzed using stochastic continuum theory. Sto-
solutions of the perturbed steady flow and
transport equations are used to construct the
scopic dispersive flux and evaluate the re-
macrodispersivity tensor in terms of a
limensional, statistically anisotropic input
ance describing the hydraulic conductivity.
statistically isotropic input covariance, the
udinal macrodispersivity is convectively con-
, but the transverse macrodispersivity is pro-
al to the local dispersivity and is several
of magnitude smaller than the longitudinal
With an arbitrarily oriented anisotropic con-
ty covariance, all components of the macro-
ivity tensor are convectively controlled,
e ratio of transverse to longitudinal dispersi-
of the order of 0.1. In this case the off-
al components of the dispersivity tensor are
ant, being numerically larger than the diag-
ansverse terms, and the transverse dispersion
s can be highly anisotropic. Dispersivities
ed by the stochastic theory are shown to be
ent with controlled field experiments and
Carlo simulations. The theory, which treats
ymptotic condition of large displacement,
es that a classical gradient transport (Fick-
lationship is valid for large-scale displace-
(Author's abstract)
0408

**ER (II) BINDING BY HUMIC ACID EX-
TED FROM SEWAGE SLUDGE: AN
TRON SPIN RESONANCE STUDY,**
e Univ., Lafayette, IN. Dept. of Agronomy.
Boyd, Le. E. Sommers, D. W. Nelson, and
West.
cience Society of America Journal, Vol 47,
p 43-46, 1983. 1 Fig, 2 Tab, 28 Ref.

ptors: *Copper, *Humic acid, *Sludge,
on spin resonance, Soil organic matter, Or-
matter, Chelation, Chemical reactions, Pro-
ate of pollutants.

g of Cu(++) by humic acid extracted from
e sludge was studied with electron spin reso-
spectroscopy. Spectral data of the Cu-humic acid complex and some adducts with nitrogen donors (pyridine, 1,10-phenanthroline, and ethylenediamine) showed that Cu(++) formed two equatorial bonds with humic acid oxygen donor ligands. The data were consistent with the formation of a copper chelate in the original Cu-humic acid complex. The ligand field strength of the humic acid oxygen donor ligands coordinated to Cu(++) was stronger than that of water. Cu(++) also appeared to form axial bonds with humic acid donor ligands originating from proteinaceous materials associated with the sludge humic acid. Characterization of an adduct with glycylglycine showed that the dipeptide formed coordinate bonds with Cu(++) bound to humic acid. (Cassar-FRC)
W84-00417

LONG-TERM IMPACTS OF SURFACE MINING ON GROUND WATER IN TEXAS DELTA PLAIN LIGNITE MINES,
C. R. Pollock.
Bulletin of the Association of Engineering Geologists, Vol 20, No 1, p 1-4, 1983. 2 Fig, 7 Ref.

Descriptors: *Groundwater pollution, *Lignite, *Mining, Texas, Groundwater resources, Water supply development, Aquifers, Water quality, Mine wastes.

Long-term hydrogeologic impacts of surface mining were investigated in 25-year-old mined land at an active delta plain lignite mine in Texas. Four monitoring wells were installed near a runoff collecting lake that occupies part of the initial box cut of the original mine. A groundwater system has developed in this old surface mined land. The water table in the resaturated spoil is at the same depth as in the pre-mine overburden, not more than 6 to 8 m below the surface. Mapping of the potentiometric surface in the mine spoil reveals that ground water in the immediate vicinity of the lake discharges to the lake. However, groundwater distant from the lake generally flows to the south-southeast in the direction of regional groundwater before mining. By studying the water chemistry of resaturated mine spoil at this active delta plain lignite mine it was determined that long-term adverse impacts of surface mining on groundwater hydrology are minimal. Resaturated mine spoil is a water table aquifer that is capable of transmitting as much water as the pre-mine overburden; mine spoil will generally resaturate within 20 years after mining. Interruptions of groundwater flow in surface mined land should be of limited duration. Spoil water quality is similar to but more mineralized than that of the pre-mine overburden water. Surface mining should not seriously degrade groundwater quality beyond the mine boundaries. (Baker-FRC)
W84-00421

THE COMPOSITION AND DEPOSITION OF ORGANIC CARBON IN PRECIPITATION,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
For primary bibliographic entry see Field 2K.
W84-00424

TRACE METALS IN A TROPICAL RIVER ENVIRONMENT - SPECIATION AND BIOLOGICAL TRANSFER,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
A. C. Paul, and K. C. Pillai.
Water, Air, and Soil Pollution, Vol 19, No 1, p 75-86, 1983. 1 Fig, 16 Tab, 13 Ref.

Descriptors: *Trace metals, *Speciation, *Rivers, *Sediments, Fish, Rice, Copper, Zinc, Cadmium, Manganese, Industrial outfall, Industrial wastes, Public health.

The transfer and uptake of trace metals such as copper, manganese, zinc, cadmium, nickel, and iron in the river environment were considered. Surface water samples were collected daily from two locations, 100 m apart, at the industrial outfall area in the river. Sediments were sampled from different locations in the river. Samples of milk were analyzed from cows grazing on the contaminated pasture at the industrial zone. Samples of fish were taken from the river. Trace metals were present in varying ratios in the dissolved and suspended fractions in river water. Trace metals, particularly cadmium and zinc showed higher concentration in sediments at the industrial zone, attributed to the industrial pollutions. All metals showed a wide range of concentration in the humic fraction of the sediments. Trace metals were higher in milk from cows fed on contaminated pasture when compared to the control cows. Analyses of fish in the river from different zones indicate varying levels of concentration in tissue. Zinc was generally concentrated in the bone as was manganese. Cadmium showed highest levels in the liver. The total intake of trace metals by a person living in the industrial zone would be calculated on the basis of the average concentration in each food item. Based on the assumption that the person consumes only the items that are produced locally it is estimated that the intake of zinc exceeds that of the reference man by about 3600 micrograms/day. The major intake, nearly 90%, is through rice grown on irrigated fields. The intake of cadmium also exceeds that of reference man, while copper and iron consumption fall short. (Baker-FRC)
W84-00426

THE MOVEMENT OF METALS APPLIED TO SOILS IN SEWAGE EFFLUENT,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, J. C. Thomas, and J. F. Slowey.
Water, Air, and Soil Pollution, Vol 19, No 1, p 43-54, 1983. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Heavy metals, *Land disposal, *Sewage disposal, Erosion, Permeability, Leaching, Soil types, Water pollution sources, Land management.

The fate of five heavy metals when applied to four diverse soils in secondary treated sewage effluent was examined. Spiking of the samples was done to simulate long term metal additions from effluents low in total metals. The sewage effluent had a mean BOD of 6.4 mg/1, a mean total organic carbon of 34.4 mg/1 and a pH of 7.8. It was spiked with sulfates of Cd, Cu, Ni, and Zn and the nitrate of Pb to concentrations which averaged 0.82, 0.83, 0.75, 0.91, and 0.74 mg/1 of each metal, respectively. The soils used were Bastrop, a udic paleustalf; Lakeland, a typic quartzipsamment; Nacogdoches, a rhodic paleudalf; and Norwood, a typic udifluvent. Subsamples of the leachate water were collected monthly from all lysimeters throughout the study to determine if any of the metals moved from the soil profiles. Results indicated that while the metals did move in the soil, none entered the leachate collected 150 cm below the surface during this study. Thus even highly permeable soils such as the Lakeland were able to retain the metals applied in sewage effluent and decrease the potential for movement in the groundwater. Since the metals did accumulate in the surface soil, good land management techniques will be needed to minimize the movement of metals via soil erosion. (Baker-FRC)
W84-00429

25 YEARS OF FISSION PRODUCT INPUT TO LAKES SUPERIOR AND HURON,
Ministry of State for Science and Technology, Ottawa (Ontario).
B. L. Tracy, and F. A. Prantl.
Water, Air, and Soil Pollution, Vol 19, No 1, p 15-27, 1983. 4 Fig, 5 Tab, 27 Ref.

Descriptors: *Radioactive wastes, *Water pollution effects, *Lakes, Great Lakes, Lake Huron, Lake Superior, Fish, Fallout, Bioaccumulation, Strontium, Cesium, Antimony, Sedimentation, Lake sediments, Sediment-water interfaces.

At the present time, virtually all fission products in the upper Great Lakes are the result of fallout from nuclear weapons testing. The concentrations of the fission products Sr-90, Sb-125, Cs-137, and Ce-144 in the water, sediments and biota of Lakes Superior and Huron were examined. No significan

differences were noted between concentrations from open water and coastal water in Lake Huron, suggesting that releases from the nuclear generating station at Douglas Point did not have a significant influence on fission product concentration. Sr-90 and Sb-125 appear to be removed from lake water primarily by radioactive decay, whereas rapid settling plays a large role for Cs-137. However, from 3 to 30% of this fission product persists in the water for many years after its introduction. Once deposited in the sediments of the upper Great Lakes, fission products remain at or near the sediment-water interface. This could facilitate their re-entry into the water and could provide an explanation of the persistence of Cs-137 in lake water. Great lakes fish contained concentrations of Cs-137 several thousand times higher than in ambient water. A health evaluation of the effects of consuming water and fish from the upper lakes over the past 25 years shows no basis for concern. The 50-yr committed dose equivalents are well within national and international limits. It is cautioned that a large scale release of fission products from a nuclear facility could lead to elevated concentrations in water and fish, and consequently to an increased radiological burden to surrounding populations for many years to come. (Baker-FRC)
W84-00430

AN ASSESSMENT OF ACID RAIN ON LEACHING OF ELEMENTS FROM DELAWARE SOILS INTO GROUNDWATER,
Delaware Univ., Newark. Coll. of Agricultural Sciences.
D. L. Sparks, and C. R. Curtis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120849, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Completion Report (1983). 18 p, 5 Fig, 2 Tab, 12 Ref. OWRT A-053-DEL(1), 14-34-0001-2108.

Descriptors: *Acid rain, *Leaching, *Groundwater pollution, *Ion transport, Soil properties, Cation exchange, Anion exchange, Leachates, Heavy metals, Delaware.

The effects of acid rain on the kinetics of elemental release from three major Delaware soil types were investigated. All three soils contained low clay and organic matter contents which would indicate rather low buffering capacities. The kinetics of elemental release were evaluated by leaching the soils with simulated acid rain at pH levels of 2.5, 3.4, 4.8, and 5.6. Leachates were collected until an apparent equilibrium in elemental release was obtained. In all soils and at all acid rain pH levels, quantities of basic elemental release were in the order Ca K Mg Na. The amount of heavy metals and Si release were very low. As the pH of the acid rain decreased, the total quantity of each released element increased. In all cases, a rapid initial release of each element was followed by slower release rates. The kinetics of Al release were characterized by a similar time trend. The greatest Al release rates occurred at pH 2.5 and from the soil type with the lowest clay and organic matter contents and thus the poorest buffering capacity. The Al that was released at pH 2.5 from the soils would probably be either monomeric or polymeric Al; however, some release could have occurred from the clay structures. Anionic release, including Ca super -, SO sub 4 super =, and NO sub 3 super -, was evaluated and found to be negligible.
W84-00434

ORGANIC CHEMICALS AND DRINKING WATER,
New York State Dept. of Health, Albany.
N. K. Kim, and D. W. Stone.
Report April 1981. 70 p, 8 Fig, 27 Tab, 22 Ref. 12 Append.

Descriptors: *Organic compounds, *Contamination, *Drinking water, *Chemical wastes, *Groundwater pollution, *Water pollution, Herbicides, Hazardous materials, Toxins, Wells.

In 1977 the New York State Department of Environmental Conservation (DEC) conducted an Industrial Chemical Survey to determine types and amounts of organic chemicals used, stored or manufactured by industries in the state. Data indicate that large quantities exist throughout the state. DEC's spill summary for 1978 shows that many accidental discharges of hazardous material and toxic chemicals occur each year. This has been documented by studies of Long Island's groundwater and upstate New York's supply wells. Some examples of the types of toxic or hazardous material spilled are sodium cyanide, acetone, chromic acid, heavy metal sludge, hydrocarbon waste, paint, pesticides, dry cleaning solvents and PCB's. Pesticides and herbicides identified in the State and Federal drinking water regulations (endrin, lindane, methoxychlor, toxaphene, 2,4-D and 2,4,5-TP Silvex) were generally not found in surface source community water systems. The data show that contamination is widespread and not restricted to a particular area of the state. In Nassau and Suffolk County wells, the most common contaminant was tetrachloroethylene. (Garrison-Omniplan)
W84-00497

SURVIVAL AND DISTRIBUTION OF AEROMONAS HYDROPHILA IN NEAR-SHORE COASTAL WATERS OF PUERTO RICO RECEIVING RUN DISTILLERY EFFLUENT,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
E. J. Biamon, and T. C. Hazen.
Water Research, Vol 17, No 3, p 319-326, March, 1983. 8 Fig, 5 Tab, 29 Ref.

Descriptors: *Bacteria, *Organic matter, *Wastewater disposal, Survival, Fate of pollutants, *Aeromonas hydrophila, Coliforms, San Juan, *Puerto Rico, Fermentation, Plumes, Pathogens.

Aeromonas hydrophila densities and water quality parameters were determined at a control station and at 5 stations in the plume of a large rum distillery discharge near San Juan, Puerto Rico. Densities of A. hydrophila varied from 10 CFU per ml at the unpolluted site to 1 million CFU per ml at the point of discharge. Densities of A. hydrophila were significantly higher in the plume than at the control site and decreased with distance from the discharge point. The density of the pathogen showed significant correlation with temperature, total phosphorus, total organic carbon, and orthophosphate. Suspensions of A. hydrophila placed in diffusion chambers at the discharge source survived and increased in density. Those placed in the unpolluted site rapidly decreased in density with time. Densities of fecal coliforms and standard count bacteria within the plume were 0.3 to 50 CFU per ml and about 1 million to 100 million CFU per ml, respectively, and were not correlated with distance from the source. (Cassar-FRC)
W84-00519

INVESTIGATIONS ON BOTTOM SEDIMENTS OF HUNGARIAN RIVERS AND RESERVOIRS. DETERMINATION OF MINERALOGICAL COMPOSITIONS BY INSTRUMENTAL ANALYTICAL METHODS,
Veszpremi Vegyipari Egyetem (Hungary). Inst. for Analytical Chemistry.
J. Hlavay, J. Kristof, J. Borszeki, F. Laszlo, and P. Literathy.
Water Research, Vol 17, No 3, p 327-332, March, 1983. 5 Fig, 7 Tab, 11 Ref.

Descriptors: *Mineralogy, *Sediments, *Adsorption, Fate of pollutants, Sajo River, Tiszar River, Kiskore Reservoir, *Hungary, Bottom sediments, Clays, Surface area, Reservoirs, Rivers.

Bottom sediments from 10 sites in the Sajo River, Tisza River, and Kiskore Reservoir, Hungary, highly polluted with industrial wastes, were analyzed to determine the mineralogical composition, organic matter content, degree of crystallinity, silicon dioxide content, quartz content, and specific surface area. These investigations, using infrared spectroscopy, thermoanalytical methods, classical analytical methods, X-ray powder diffraction, and vapor absorption measurements, showed that properties of sediments from all the sites and the connected reservoir differed only slightly. This indicates that the sediments studied have simil
ities to adsorb heavy metals and to sett
similar rates. Specific surface areas were 8
m per g, with the higher values obtained f
voir samples. (Cassar-FRC)
W84-00527

THE EFFECT OF SEDIMENT ON THE GRADATION OF 2,4,6-TRICHLOROP IN DELAWARE RIVER WATER,
Rutgers - The State Univ., New Brunsw
Dept. of Environmental Science.
L. A. Blades-Fillmore, W. H. Clement, and Faust.
Journal of Environmental Science and Hea A, Vol 17, No 6, p 797-818, 1982. 11 Fig, 1 Ref.

Descriptors: *Phenols, *Degradation, *Se Fate of pollutants, *Trichlorophenol, Su sediments, Biodegradation, Microbial degr Organic compounds, *Delaware River.

Water and bottom sediment from 11 site Delaware River from Mile 146 (Wash Crossing) to Mile 63 (New Castle) were studies of 2,4,6-trichlorophenol (TCP) bio tion (initial concentration, 50 microgra liter). Incubation of sterilized control showed no degradation during the 22 days and very little adsorption onto sedimen sampling site had no correlation with deg rate in either water or water/sediment Water systems showed a lag period seve before TCP degradation began; water/s systems did not. Averaged half-lives we ment/water, unstirred, 7.6 days; water alo days. Using different substrates half-live glass beads, 5 days; sterile gravel, 10 days sand, 13 days. The relationship between su sediment and rate of degradation was indic the following half-lives: 7 days for a 1 g suspension. A positive relationship was sh the rate of biodegradation and exposed area. This study showed that surfaces for b attachment play an important role in m degradation. (Cassar-FRC)
W84-00577

DEGRADATION OF SELECTED P LUREA HERBICIDES BY ANAEROBIC SEDIMENT,
Clemson Univ., SC. Dept. of Microbiology
H. H. Attaway, III, M. J. B. Paynter, and N Camper.
Journal of Environmental Science and Heal B, Vol 17, No 6, p 683-699, 1982. 6 Tab,

Descriptors: *Herbicides, Degradation, Sed *Monuron, *Diuron, *Fenuron, *Microbial dation, Anaerobic conditions, Ponds, Fate lutants, Urea pesticides, *Anaerobic digestio

Anaerobic degradation of the herbicides monuron and fenuron in pond sediments wa tigated. Sediment from a diuron-treated po halogenated diuron to 3-(3-chlorophenyl) methylurea in 17-25 days. Sterile sedimen ments from non-diuron-treated ponds, or in faces of clay, sand, or cellulose did not d diuron. Degradation occurred at 25 and 3 not at 37C or at 15C or below. Degradati most rapid at 30C. Diuron-treated sediment under refrigeration for 8 months retained its to degrade diuron. Monuron, 3-(4-chlorop 1,1-dimethylurea, and fenuron, 1,1-dime phenylurea, were not degraded by pond sed The fact that the para-chlorine of monur not removed implies that the enzyme(s) resp for reductive dehalogenation requires electi tivity of the meta-chlorine, as in diuron. (FRC)
W84-00578

SURVIVAL OF ENTERIC VIRUSES AND CATOR BACTERIA IN GROUNDWATER
Texas Univ. Medical School at Houston.
B. H. Keswick, C. P. Gerba, S. L. Secor, and Cech.
Journal of Environmental Science and Healt A, Vol 17, No 6, p 903-912, 1982. 2 Tab,

tors: *Bacteria, *Viruses, *Groundwater, pollutants, Enteric bacteria, Enteroviruses, rs, Survival, Public health.

and viruses survived in flowing ground- r the 24-day duration of a laboratory ex- t using organisms on Nucleopore polycar- membranes in McFeter's survival cham- ater flow was continuous at 0.5 to 5 liters and 3 to 15C. Decay rates (as log (concen- after 24 hours/initial concentration)) in r day were: Coliphage f2, -0.39; Rotavirus 0.36; Escherichia coli, -0.32; Fecal strepto- -0.23; Poliovirus 1, -0.21; and Coxsackie- , -0.19. (Cassar-FRC)
579

ALUATION OF THREE PESTICIDE F LOADING MODELS,
mental Research Lab., Athens, GA.
orber, and L. A. Mulkey.
of Environmental Quality, Vol 11, No 3, p 1982. 2 Fig, 17 Tab, 22 Ref.

ors: *Pesticides, *Nonpoint pollution *Sediment transport, Atrazine, Toxa- nsecticides, Model studies, Runoff, Fate of s, Agricultural watersheds, Erosion, Sedi- eld, Cotton, Agricultural runoff manage- odel, Continuous pesticide simulation, l runoff and erosion from Agricultural ient Systems.

onpoint source runoff models were com- r their ability to predict the movement of s (toxaphene and atrazine) from water- he models were Agricultural Runoff Man- (ARM), Continuous Pesticide simulation nd Chemical, Runoff, and Erosion from ural Management Systems (CREAMS). xaphene losses (g per ha for a 12-month from a cotton plantation on a 15.6 ha pi Delta watershed were: ARM, 105.98; .67; CREAMS, 105.85, and observed, osion (tons per ha) for the same site and ere: ARM, 25.73; CPS, 27.93; CREAMS, nd observed, 26.25. Runoff predictions hin 15% of observed values. Prediction of nts varied widely among the models, with S values for runoff, soil loss, and toxa- ss generally less than half those of the odel, and CPS values less than 40% of alues. Predicted atrazine losses from a uthern Piedmont watershed were very r all three models. (Cassar-FRC)
84

ELEMENT RELEASE TO GROUND- AT IN-SITU URANIUM MINING HASE I,
g Univ., Laramie. Dept. of Civil Engi-

menick, W. L. Dam, and J. I. Drever.
from the National Technical Information Springfield, VA 22161 as PB84-132505, es: A05 in paper copy, A01 in microfiche. Research Center Completion Report, 1983. 75 p, 16 Fig, 5 Tab, 55 Ref, 5 OWRT A-037-WYO(1), 14-34-0001-2154.

ors: *Mine wastes, Groundwater pollu- ybdenum, Vanadium, Arsenic, Selenium, Leaching, Mass transfer, Wyoming, ne ores, *Heavy metals, Texas.

oratory experimental research project the mechanism and kinetics of release of ements to groundwater from sandstone ch have been mined by an in-situ leach and subsequently subjected to ground- w through the mined area. Ore's from and Texas were examined during the d heavy elements of interest were urani- bdenum, vanadium, arsenic, and seleni- mechanism of release was found to be d by diffusion. The kinetics of release deled by an overall mass transfer relation- der conditions of the experiments, the ements were calculated to be anionic in ata were obtained and processed to pro- ired information to simulate field condi- tions when evaluating heavy element migration at uranium solution mining sites.
W84-00637

TIME OF TRAVEL OF THE FLINT RIVER, UTAH DAM TO HIGHWAY M-13, MICHIGAN: AUGUST 4-8, 1981,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-00647

VERTICAL MOVEMENT OF GROUND WATER UNDER THE MERRILL FIELD LAND- FILL, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
G. L. Nelson.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $3.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-1016, 1982. 34 p, 8 Fig, 1 Tab, 5 Ref.

Descriptors: *Groundwater, *Hydraulics, Deep percolation, Sanitary fills, Vertical permeability, Aquifer testing, *Alaska, Anchorage.

Shallow groundwater under the Merrill Field sanitary landfill at Anchorage is polluted by leachate. Wells, including three Municipal-supply wells, obtain water from two confined aquifers 100-300 feet beneath the landfill area. Aquifer-test data and information on subsurface geology, ground-water levels, and properties of materials were used to estimate vertical gradients and vertical permeabilities under the landfill. The authors 'best estimates' of vertical permeabilities of two confining units are 1 x 10 super -2 foot per day and 2 x 10 super -4 foot per day. Theoretical travel-time calculations indicate that minor amounts of pollutants may reach the upper confined aquifer after many tens of years, but that water of the composition of the leachate probably would not reach the aquifer for more than three centuries. The range of error in the theoretical travel-time calculations is likely to be plus or minus a factor of two or three. (USGS)
W84-00648

ASBESTOS IN WATER SUPPLIES OF THE NORTHERN NEW JERSEY AREA: SOURCE, CONCENTRATION, MINERALOGY, AND SIZE DISTRIBUTION,
Rutgers - The State Univ., Newark, NJ. Dept. of Geology.
J. H. Puffer, G. P. Maresca, and M. Germine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136811, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute. Center for Coastal and Environmental Studies Completion Report, Rutgers Univ., New Brunswick, N.J., August 1983. 87 p, 22 Fig, 10 Tab, 122 Ref, 4 Append. OWRT A-067-NJ(1), 14-34-0001-2132.

Descriptors: *Asbestos, *Water supply, Bedrock, Drinking water, *Groundwater, Minerals, Quarries, Reservoirs, Rivers, Pollution, X-ray, Electron Microscopy, Rutile, Titanium oxide, Chrysotile, Crocidolite, Tremolite-Actinolite, *New Jersey, Staten Island, New York.

On the basis of the distribution of asbestos in the northern New Jersey area, four principal target areas were investigated for contamination of water supplies by bedrock asbestos: Staten Island, N.Y., Mendham, N.J., Franklin, N.J., and Easton, Pa. In the Silver Lake Reservoir in Staten Island, N.Y., where chrysotile from serpertinite bedrock exposures is a potential source of contamination, chrysotile asbestos levels of 15 to 86 million fibers per liter (MFL) were measured, with an average of 53 MFL. In Mendham, N.J., ground and surface water sources of municipal drinking water range in crocidolite fiber content from 0 to 4.7 MFL and probably originates from a major crocidolite-bearing fault zone that runs through the town. Franklin, N.J. was investigated to determine whether quarry runoff was contaminating a downstream water supply. Significant amounts (1.1 to 2.0 MFL) of tremolite-actinolite asbestos were found in a stream receiving quarry runoff. Asbestos levels of 0.3 to 3.45 MFL were found in the municipal supply, and probably result from a combination of natural bedrock erosion, ambient environmental contamination, and quarry runoff. Tremolite-asbestos from faulted marble was suspected as a contaminant of College Hill Reservoir, in Easton, Pa. However, asbestos levels at this location were not significantly above background.
W84-00683

5C. Effects Of Pollution

CHANGE IN QUALITY OF A SINGLE RIVER'S WATER ON ITS PASSAGE THROUGH TWO RESERVOIRS, LAKE BOIVIN AND GRANBY RESERVOIR (TRANSFORMATION DE LA QUALITE D'UNE MEME EAU DE RIVIERE LORS DE SON SEJOUR DAN DEUX RESER- VOIRS DIFFERENTS: (A) LE LAC BOIVIN ET (B) LA RESERVE DE GRANBY, QUEBEC, CANADA),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. G. C. Campbell, D. Cluis, and P. Couture.
Canadian Water Resources Journal, Vol 7, No 1, p 127-150, 1982. 3 Fig, 7 Tab, 23 Ref.

Descriptors: *Reservoirs, *Water quality, Nitrogen, Phosphorus, Algal growth, Chlorophyll A, Nutrients, Quebec.

Nitrogen and phosphorus dynamics were studied during a 20-month period in two adjacent reservoirs used by the city of Granby, Quebec, Canada, for domestic and industrial water supplies. The two impoundments have a common water supply, the North Yamaska River, but differ considerably in their physical and biological characteristics. The river water entering the two reservoirs was highly enriched in phosphorus, reflecting land use practices in the upstream watershed. Concentrations of dissolved phosphorus at the inlet greatly exceeded the generally accepted water quality standards for standing waters. During summer stagnation, a lagged relationship was observed between indigenous phytoplankton chlorophyll-a and algal growth potential. Fluxes through each reservoir for a variety of parameters, including chlorine, conductivity, inorganic nitrogen, total phosphorus, algal growth potential, and chlorophyll-a, were calculated from data on concentrations and discharge measured at the inlet and outlet of each impoundment. Mass balance analysis showed that the two reservoirs were similar with respect to chlorine, inorganic nitrogen, phosphorus, and chlorophyll-a, but differed significantly with respect to the algal growth potential. The input-output budgets for algal growth potential were balanced in the main-stream reservoir, but were strongly negative in the off-channel reservoir. The implications of the study results for the modeling of water quality in other reservoirs are briefly discussed. (Carroll-FRC)
W84-00370

THE EFFECT OF THERMAL EFFLUENT, BEFORE AND AFTER MACROPHYTE HAR- VESTING, ON STANDING CROP AND SPE- CIES COMPOSITION OF BENTHIC MA- CROINVERTEBRATE COMMUNITIES IN LAKE WABAMUN, ALBERTA,
Calgary Univ. (Alberta). Dept. of Biology.
J. B. Rasmussen.
Canadian Journal of Zoology, Vol 60, No 12, p 3196-3205, 1982. 6 Fig, 4 Tab, 49 Ref.

Descriptors: *Thermal pollution, *Temperature effects, *Benthic environment, Alberta, Lakes, Lake Wabamun, Canada, Heated water, Macroinvertebrates, Oligochaetes.

Prior to macrophyte harvesting the heated area of Lake Wabamun had higher submerged macrophyte production, greater amounts of plant detritus in the sediment, and a higher standing crop of benthic macroinvertebrates than the unheated area. In the heated area the warmest spots supported a community dominated by tubificid oligochaetes, and the moderately heated areas supported com-

munities dominated by large Chironomus, mainly of smaller chironomid species. The heated area was subjected to mechanical macrophyte harvesting, which removed the majority of the submerged macrophytes. This reduced the amount of plant detritus within the sediment and also the standing crop of benthic macroinvertebrates in the heated area. Species composition of the oligochaete-dominated community was not affected by harvesting. Species composition of the Chironomus-dominated area was greatly affected by harvesting and became more similar to that of the unheated area, with densities of the large Chironomous species being reduced to low levels, while the densities of smaller chironomid species increased. These findings suggest that the effects of thermal effluent on benthic animal communities in Lake Wabamun are partly a consequence of increased macrophyte production and the accumulation of detritus. However, the details of this interaction are obscure. (Baker-FRC)
W84-00376

OXYGEN DEMAND OF TACONITE TAILINGS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-00384

TRACE METALS IN A TROPICAL RIVER ENVIRONMENT-DISTRIBUTION,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
A. C. Paul, and K. C. Pillai.
Water, Air, and Soil Pollution, Vol 19, No 1, p 63-73, 1983. 1 Fig, 14 Tab, 14 Ref.

Descriptors: *Trace metals, *Rivers, *Distribution, Zinc, Cadmium, Industrial wastes, Monsoons, Periyar River, Sediments, Water pollution effects, India.

The distribution of trace metals in the Periyar Rive. in Kerala and its backwaters was studied from 1976 to 1980. The river from Kalady to Mcolampalli, a distance of about 50 km, has been divided into 3 zones: background, industrial, and backwater. In view of the overwhelming impact of monsoon runoff in the river flows a seasonal separation of the studies between monsoon and non-monsoon periods has been made. Background concentrations of trace metals increased in the river water during the summer partly due to increased solubilization and partly due to concentration through evaporation. The sediments also reflect the corresponding seasonal changes in the concentrations. There is preferential concentration of the finer particles that remain suspended. Meandering of the stream during monsoon, which results in reduction of flow velocity, is responsible for large scale deposition of suspended solids at the industrial zone. Industrial effluent discharge enhances the concentration of Zn and Cd, both in the water and in the sediments, in the industrial zone. The concentration of Mn and Cd in the water approaches the recommended safe limits for drinking water. Deleterious effects on smaller organisms are reported and possible synergistic effects are cited as the river is the recipient of a wide variety of chemical pollutants. There is also evidence for solubilization of trace metals in the backwater zone under the influence of higher salinity in summer. Solubilization may be regarded as a significant property by which the trace metals get transported to the marine regime. (Baker-FRC)
W84-00427

GROWTH RESPONSE AND SPECTRAL CHARACTERISTICS OF A SHORT SPARTINA ALTERNIFLORA SALT MARSH IRRIGATED WITH FRESHWATER AND SEWAGE EFFLUENT,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 7B.
W84-00431

NITROGEN CYCLING AND PHOTOPLANKTON GROWTH IN THE NEUSE RIVER, NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Inst. for Coastal and Marine Resources.
D. W. Stanley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120906, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 204, North Carolina State Univ., Raleigh, August 1983. 92 p, 7 Fig, 7 Tab, 38 Ref. OWRT A-126-NC(1), 14-34-0001-2135.

Descriptors: *Eutrophication, *Nitrogen compounds, *Nitrogen cycle, *Phytoplankton, *Algal growth, *Rivers, *Estuaries, Nutrients, Nitrogen, Ammonia, Ammonification, Nitrates, Chlorophyll A, Algae, Bacillariophyceae, Chlorophyta, Dinoflagellates, Bacteria, River flow, Municipal wastewater, Wastewater disposal, North Carolina.

As part of an effort to understand the relationships between nutrient dynamics and nuisance algal blooms, this study addresses the transfers (among the air, water, sediments, and microorganisms) and transformations (from one form of the nutrient to another) of nitrogen nutrients as they travel through the Neuse River. Two sampling sites were chosen, but there was not as much difference in N kinetics between the upriver and downriver stations as had been anticipated. This probably stemmed from the fact that river flows were relatively high during the study, and the downriver area experienced riverine conditions (high dissolved inorganic nitrogen, low algal productivity), rather than the estuarine conditions (low DIN, high algal productivity) typical of other years. Phytoplankton biomass in the river was closely correlated (inversely) with river discharge rate. About 80% of the DIN assimilate by algae and bacteria in the river was NH sub 4-N, even though NO sub 3-N concentrations were usually 5-10 fold higher than NH sub 4-N. Significant NOsub 4-N utilization can be expected to occur only if the NH sub 4-N becomes depleted. During this study, NH sub 4-N did not become depleted because ammonification rates usually were high enough to provide enough DIN to supply the assimilation needs. Given the rapid recycling of NH sub 4-N and the large reservoirs of NO sub 3-N in the Neuse, DIN inputs will need to be reduced greatly before N limitation can act to control algal production.
W84-00440

EVALUATION OF ACID RAIN SENSITIVITY OF PENNSYLVANIA SOILS,
Pennsylvania State Univ., University Park. Coll. of Agriculture.
E. J. Ciolkosz, and E. R. Levine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120922. Price codes: A06 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, The Pennsylvania State University, University Park, September 1983. 106 p, 7 Fig, 8 Tab, 157 Ref. OWRT A-058-PA(1), 14-34-0001-2140.

Descriptors: *Acid rain, *Soils, *Acid deposition, *Soil buffer capacity, *Soil acidification, *Computer simulation model, Cation exchange, Sulfate adsorption, Base saturation, Acidity, Mineral degradation, Aluminum hydrolysis, pH, Aluminum toxicity, Cation leaching, Soil sensitivity, Simulation, Prediction equations, Atmospheric sulfur, Atmospheric nitrogen.

Pennsylvania shares with its neighboring states the most acidic deposition that falls in the United States. The effect of acidity in the deposition on soils has not been fully evaluated. A computer simulation model was developed to determine the impact of various inputs of acid deposition on Pennsylvania soils. The model simulates the changes that occur in the solid phase of soils in humid, temperate climates that are undergoing acidification and cation leaching. To obtain predicitons about soil properties which closely matched actual field conditions, the state was divided into 10 regions based on physiography, county borders, and proximity to 1 of the 10 precipitation monitoring stations established by the Pennsylvania Department of Environmental Resources. Information from The Pennsylvania State University Soils Data Base for the major soil associatio each of these 10 regions, and the acco precipitation data, were used as input to t Simulations creating the 'worst case scen designed using data for uncultivated an soils, and without a forest canopy or lit Soils were classified into sensitivity cla on the amount of time required for the so a threshold value of pH less than or eq aluminum concentration in the soil solut mg/l in the upper horizon,or aluminum c tion in the soil solution of 0.1 mg/l in horizon. Very sensitive soils reached a value within 30 years, sensitive soils att value within 60 years, slightly sensi reached it within 90 years; non-sensitive not attain critical levels within 90 years. model, simulation results showed the Pen soils were either very sensitive or non Soils at the threshold values at the beginn simulation were very sensitive, while th the critical levels from the start of the were classified as non-sensitive. Thus, sensitive soils contain sufficient buffer c withstand acid deposition inputs at pre for at least 90 years. Correlation analysi results indicates that base saturation, exc cations, exchangeably acidity, and pH closely associated with the sensitivity of vania soils to acid deposition. Cation capacity and sulfate adsorption showed association with soil sensitivity class pre the model.
W84-00442

THE EFFECTS OF POWER STATION ING WATER DISCHARGES ON A ECOLOGY,
Central Electricity Generating Board, head (England). Biology Dept.
G. D. Howells.
Water Pollution Control, Vol 82, No 1, 1983. 7 Fig, 2 Tab, 32 Ref.

Descriptors: *Cooling water, *Aquatic lif mal pollution, Heated water, Water pol fects, Reviews, Powerplants, Ecology, F perature effects, Insects, Chlorine, Olig Crustaceans, Invertebrates, *United King

The properties and effects of cooling w chargers from powerplants in the United were reviewed. In this country the nat peratures of rivers used for cooling wate 22C. Heated water discharges raise the tures to 8-10C above ambient. Stratifica low flow can produce considerably hig peratures for brief periods. Lethal ten limits for fresh water fish are usually ab Previous exposure and adaptation are i factors. Data on preferred temperatures fo conflicting. Chlorine residuals above 0.5 liter are regarded as lethal to marine a water fish; lower concentrations can distu ger animals or sensitive species (such as C or some biological functions. During p cooling water through the tower, dissolve is greatly increased, carbon dioxide is d and nitrification takes place. Downstre heated water discharges oligochaetes are merous than at control sites. Crustacea a complete their life cycles more rapidly in water. Effects on insect emergence patte difficult to ascertain because of the wid variability in emergence patterns. Fish receiving cooling water discharges tend toward the warm water in winter and summer. Discrepancies between laborat field studies showed the need for furth (Cassar-FRC)
W84-00480

EVALUATION OF HIGH AND PROL LEVELS OF SEWAGE WASTEWAT MARSH VEGETATION,
Delaware Univ., Newark. Coll. of Marine
F. C. Daiber, M. A. Hardisky, and P. L. W
Available from the National Technical Inf Service, Springfield, VA 22161 as PB84 Price codes: A04 in paper copy, A01 in mi Completion Report, September 1983. 70 p 9 Tab, 47 Ref. OWRT A-054-DEL(1).

criptors: *Cycling nutrients, Nitrogen, Ni-
es, Ammonium, Tidal marshes, Salt marshes,
etlands, Nutrient removal, Plant growth,
tewater, Sewage, Sanitary wastewater,
tewater outfall, Wastewater disposal, Water
ysis, Chemical analysis, Saline water, Vegeta-
Nutrients, Limiting nutrients, Delaware, Kent
nty, Murderkill River Marshes.

partina cynosuroides marsh bordering a tidal
receiving sewage effluent was compared with a
lar marsh on a tidal gut receiving no sewage
ent. S. cynosuroides annual net aerial primary
luctivity ranged from 313-746 gdw m-2 yr-1
was similar for the effluent and control
shes. If all plant species are included in the
ary production calculation, the marsh on the
ent creek averaged 1050 gdw m-2 yr-1 and the
h on the control creek averaged 800 gdw m-2
The decomposition of S. cynosuroides leaves
stems from litter bags suggested that decompo-
n in the effluent marsh was significantly faster
in the control marsh. Analysis of plant tissue
ated plants in the effluent marsh had a signifi-
y higher nitrogen concentration than plants
the control marsh early in the growing
on. Near the end of the growing season, plants
the effluent marsh had lower or similar nitro-
concentrations to the plants from the control
h. Despite very high concentrations of ammo-
n the tidal water flooding the effluent marsh,
y uptake of nitrogen by S. cynosuroides ap-
ntly did not occur. Lower soil salinities result-
from the large input of sewage effluent also
ributed to the observed differences between
ontrol and effluent marshes.
-00494

**EFFECTS OF UNBALANCED AMMONIA
BOD CONCENTRATIONS ON OXIDA-
N PONDS,**
Gurion Univ. of the Negev, Sde Boker
el). Lab. for Environmental Applied Microbi-
y.
beliovich.
er Research, Vol 17, No 3, p 299-301, March
4 Fig, 1 Tab, 8 Ref.

riptors: *Ammonia, *Photosynthesis, *Oxida-
ponds, Wastewater treatment, Anaerobic con-
ns, Water quality, Oxygen, Toxicity, Water
tion effects, Biological oxygen demand,
ewater lagoons, Lagoons, Ponds, Reservoirs.

ammonia concentrations in an oxidation pond
uced poor water quality in the receiving reser-
in spite of low effluent BOD levels. Although
ond effluent BOD was much lower in 1981
in 1980, the reservoir BOD was nearly the
, about 45 mg per liter, in both years; the
onia concentrations in the reservoir were 25
37 mg per liter in 1980 and 1981, respectively.
nonia levels were inversely correlated with
synthesis rates and with BOD levels in the
voir. As a result of the low rate of photosyn-
s, oxygen levels in the reservoir were low. To
tain a satisfactory water quality in the effluent
reservoir, the oxidation pond systems must be
ated so that the ammonia and BOD levels both
ease simultaneously. (Cassar-FRC)
-00521

**LOGICAL CONSIDERATIONS IN THE
TING OF QUALITY STANDARDS FOR
TIDAL THAMES,**
Andrews, J. E. C. Steel, and A. G.
burn.
er Pollution Control, Vol 82, No 1, p 52-60,
1 Fig, 4 Tab, 46 Ref.

riptors: *Water quality standards, *Species
osition, *Aquatic populations, Water pollu-
effects, Standards, Estuaries, Thames River,
ted Kingdom, Fish, Invertebrates, Marine ani-
Dissolved oxygen, Oxygen.

gical standards for water quality in the
nes Estuary were established, using 5 catego-
(A to E, good to anoxic respectively), each
ed by the composition of the populations of
atory fish, estuarine fish, and estuarine ma-
croinvertebrates. These were correlated with dissolved oxygen values. During periods of recovery from pollution the rate of recovery is most rapid in fish, followed by mobile invertebrates, and then sedentary invertebrates. For example, a C quality water (poor) with a C estuarine invertebrate community may contain a B fish population, indicating improving water quality, or a D fish population, indicating worsening conditions. The third quarter minimum dissolved oxygen level of the Thames increased from 5.5% in 1968 to 44.2% in 1979. This was reflected by changes in the aquatic community: establishment of the prawn Palaemon longirostris in 1976, invasion of marine invertebrate species, and the increasing presence of smelt and rainbow trout, formerly sighted only on rare occasions. (Cassar-FRC)
W84-00523

POTENTIAL HAZARDS OF NITRATE AND FLUORIDE IN UNDERGROUND WATER,
R.B.S. Coll., Bichpuri (India). Dept. of Agricultural Chemistry and Soil Science.
For primary bibliographic entry see Field 5A.
W84-00528

SIGNIFICANCE OF EUTROPHICATION IN WATER SUPPLY RESERVOIRS,
W. W. Walker, Jr.
Journal of the American Water Works Association, Vol 75, No 1, p 38-42, January, 1983. 4 Fig, 35 Ref.

Descriptors: *Eutrophication, *Storage reservoirs, *Phosphorus, *Water quality control, *Watershed management, *Phosphorus removal, *Literature reviews, Model studies, Reviews, Organic loading, Organic carbon, Water pollution effects, Water supply, Limiting nutrients, Costs.

Some key relationships between eutrophication of surface water supplies and the costs and quality of finished water are reviewed. In view of current concerns over organohalides, problems with organics are most significant. Data from lakes and reservoirs in the United States show a positive correlation between total phosphorus and total organic carbon measurements. This correlation is indicative of the role of phosphorus as the limiting nutrient in the growth of aquatic plants and algae. The control of phosphorus export in watersheds is a potentially significant and cost-effective means of dealing with organics-related problems. Regionally-calibrated empirical models may be used with reservoir and watershed monitoring data to assess the extent, significance and controllability of phosphorus-related water quality problems. Water shed assessments also provide a means of arriving at local solutions to organics-related problems and of formulating land-use policies to protect water quality. (Geiger-FRC)
W84-00571

THE SENSITIVITY OF CEDAR SWAMPS TO THE EFFECTS OF NON-POINT SOURCE POLLUTION ASSOCIATED WITH SUBURBANIZATION IN THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
J. G. Ehrenfeld, and J. P. Schneider.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136779, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September 1983. 42 p, 31 Fig, 32 Tab, 39 Ref, 8 Append. OWRT A-065-NJ(1), 14-34-0001-2132.

Descriptors: *Nutrients, *Non point pollution sources, *Swamps, Wetlands, *Urbanization, *Water pollution effects, Water level fluctuations, Plant communities, Plant growth, Urban watersheds, Heavy metals, Cedar bogs, Cedar trees.

Nineteen swamps dominated by Chamaecyparis thyoides were chosen to represent the following gradient of increasingly severe impacts due to watershed development: (1) isolated sites, far from roads; (2) isolated sites, near roads; (3) suburban sites with indirect runoff; and (4) suburban sites receiving storm sewer input. In both types of suburban sites, 'typical' Pine Barrens species were lost and many weeds and exotics invaded. Herb, shrub and fern densities did not change significantly along the gradient. The sites receiving storm sewer input showed an increased uptake of phosphorus and lead, but no significant changes for N, Cu or Zn; sites with indirect runoff showed no changes in tissue element concentrations. Sphagnum cover and cedar seedling density decreased sharply with disturbance. Cedar growth rate was found to be a complex function of tree age and site type; there was some evidence of increased increment growth with age in both kinds of suburban sites. In summary, the presence of direct stormwater input to cedar swamps causes marked changes in community structure, vegetation dynamics, and plant tissue element concentration. Developed watersheds, or even roads proximate to swamps, also cause changes, though less drastic, from conditions in swamps in undisturbed areas.
W84-00682

IMPACT OF CHANGING ACIDITY ON THE TROPHIC DYNAMICS OF PINE BARRENS PLANKTON COMMUNITIES,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
M. D. Morgan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136803, Price codes: A03 in paper copy, A01 in microfiche. U.S. Dept. of the Interior, OWP. Center for Coastal and Environmental Studies Completion Report, Rutgers Univ., New Brunswick, N.J., September 1983. 38 p, 17 Fig, 3 Tab, 27 Ref. OWRT A-066-NJ(1), 14-34-0001-2132.

Descriptors: *Zooplankton, *Acid deposition, Nutrients, Bosmina coregoni, Lakes, Primary productivity, Hydrogen-ion concentration, *New Jersey, *Pine Barrens, Ponds, Oswego Lake, Nescochague Lake.

The physical, chemical, and biological limnology of Oswego Lake (an undisturbed New Jersey Pine Barrens pond), and Nescochague Lake (a pond disturbed by extensive agricultural and residential development) was investigated from June 1981 - May 1983. The impact of disturbance was most evident in pH and nutrients. On all occasions, the pH of Nescochague Lake (mean, based on H super + concentration = 5.3, range 4.5-7.8) exceeded the pH of Oswego Lake (mean - 4.2, range 3.9-4.6). Concentrations of NO sub 3 -N and total P were about 50 times greater in Nescochague Lake than in Oswego Lake (NO sub 3 -N range from 200-800 and 1-25 ug/L, respectively, and total P ranged from 240-600 and 2-16 ug/L, respectively). The biological response to these differences was most evident among the phytoplankton, which exhibited both greater biomass and productivity. Surprisingly, in view of the major differences in pH, the zooplankton communities of these ponds, except for differences in density, were quite similar. Over the two years studied, 35 species were collected from Oswego Lake and 29 from Nescochague Lake. Only 6 species were unique to Oswego Lake and none were unique to Nescochague Lake. In addition, both ponds were dominated by the same species (Bosmina coregoni in the spring and summer, and Eucyclops agilis and Chydorus brevilabris in the fall and winter). Field and laboratory experiments demonstrated that much of the increased pH of Nescochague Lake was a temporary result of high rates of photosynthesis, so that in the winter and at night, the pH approached levels characteristic of Oswego Lake. These periodic reductions in pH apparently restricted the zooplankton to a primarily acid tolerant assemblage, thus, explaining the overall similarity between the communities in Oswego and Nescochague Lakes. Alteration of Nescochague Lake pH in experimental enclosures confirmed this conclusion.
W84-00684

5D. Waste Treatment Processes

WASTEWATER TREATMENT BY SOILS: ROLE OF PARTICLE SIZE DISTRIBUTION,

Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
V. Tare, and S. D. Bokil.
Journal of Environmental Quality, Vol 11, No 4, p 596-602, October-December, 1982. 9 Fig, 5 Tab, 18 Ref.

Descriptors: *Wastewater disposal, *Particle size, *Land application, Wastewater treatment, Soil properties, Sand, Silt, Land disposal, Ammonia, Nitrogen removal, Phosphates, Coliforms, Bacteria, Chemical oxygen demand.

Wastewater was treated by percolation through 7.5 cm diameter soil columns containing 100% sand, 100% silt, and mixtures in the proportions 80:20, 60:40, 40:60, and 20:80. Particle size distribution of the soil was a significant factor in effective wastewater treatment. A 60:40 sand:silt mixture was most suitable, combining the faster percolation rates of the sand with the better pollutant assimilation of the silt. A formula was developed for COD removal in soil as a function of depth. For the optimum soil system used in this study the depth below which no significant COD removal occurred was 45 cm. The overall COD reduction rate increased for about 16 days after initiation of wastewater flooding, then decreased, indicating that wastewater application should not be continuous but alternated with dry periods. Although phosphate removal was complete at <15 cm depth in soils containing part silt, 1-2 mg per liter phosphate was found in effluents at the 30 cm depth in sand. Removal of ammonia and total N was dependent on soil particle size, soil sorptive capacity and cation exchange capacity. Coliform concentrations were reduced by 1 order of magnitude in the sand and to zero in the optimum soil system. (Cassar-FRC)
W84-00352

IMPROVEMENT OF WATER USE EFFICIENCY IN IRONWORKS (RATIONALISIERUNG DER WASSERVERWENDUNG IN BETRIEBEN VON EISENHUTTENKOMBINATEN),
Forschungsinstitut fuer Wasserwirtschaft, Prague (Czechoslovakia).
P. Dockal.
Wasserwirtschaft-Wassertechnik, Vol 32, No 8, p 275-276, 1982. 4 Tab, 7 Ref. (No English Summary).

Descriptors: *Industrial water, *Refinery wastes, *Water cooling, *Wastewater treatment, *Pollution, Industrial wastewater, Cooling, Canals, Technology, Temperature, Oil, Suspended solids.

Iron and steel industries are among the largest consumers of water, requiring large quantities for various uses. In the last 10 years, new methods of recycling industrial waters have been developed. Experience has shown that increasing demands for steel quality result in greater wastewater pollution. New wastewater reuse methods are illustrated, based on a mixed-type plant including the Neue Hutte Ostrava. Water economy is visualized in terms of open and closed loops. Well planned recycling has minimized pollution under normal conditions, but breakdowns and work schedule changes can interfere with these plans. Principal efforts in the next few years should probably be directed toward dissipation of waste heat, minimizing the effects of operational interruptions, and improving wastewater treatment in the individual processes. (Titus-FRC)
W84-00356

SKOOKUMCHUCK DECOLORIZATION MEETS HIGH EXPECTATIONS.
Pulp and Paper Journal, Vol 35, No 5, p 12, 14, 1982. 2 Fig

Descriptors: *Wastewater treatment, *Color, *Settling ponds, *Infiltration, Organic compounds, Canada, Industrial wastes, Kootenay River.

The $2.5 million rapid infiltration decolorization system installed in the fall of 1981 for a forestry operation in Canada effectively eliminated 90% of the effluent color which was formerly contaminating the nearby Kootenay River. The process begins with the effluent percolating through the soil, so that the dissolved organic solids were precipitated by soluble ions characteristic of the soil in the Kootenay River valley. These larger size insoluble molecules are then filtered by the soil. During the rest period, decomposition of some of the organic components left in the soil generates carbon dioxide which locally acidifies soil particles, thus releasing more soluble ions for the next dosing cycle. The treatment system also includes a polishing step, where the effluent remains in a 2.5 day basin to remove solids biologically generated in the aeration pond. It is after this polishing step that the rapid infiltration system comes into play. To evaluate effectiveness of the system at Skookumchuck, a total of 31 monitoring wells were drilled for a cumulative depth of about 2,800 feet. These wells have been installed to monitor groundwater hydrology and the effect of effluent on groundwater quality. (Baker-FRC)
W84-00360

EMPLOYING ACUTE AND SUBACUTE TOXICITY MEASUREMENTS IN ON-SITE BIOMONITORING STUDIES,
Weyerhaeuser Co., Tacoma, WA. Environmental Technical Dept.
J. N. Fisher.
Tappi Journal, Vol 65, No 11, p 89-91, November, 1982. 2 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Effects of pollution, *Pulp and paper industry, Industrial wastes, Fish, Toxicity, Regulations, Secondary wastewater treatment.

On-site monitoring of pulp and paper mill effluents was conducted at various sites in 1978-1980. Since installation of technology designed to comply with the Best Available Technology (BAT) requirement of the EPA designation could be costly, information was specifically sought which might indicate that a waiver could be requested from BAT installation. Pulp and paper effluents from well-operated secondary treatment systems showed little or no acute toxicity to fish. Even though raw effluent toxicity varied widely, secondary treatment systems were 90-95% efficient in removing acute toxicity. Avoidance and leucocrit responses in test fish occurred in the range of 0.4-0.7 times the median lethal concentrations. Finally, mill bioassay profile results compared with effluent instream concentrations suggest no effect on resident fish populations. (Baker-FRC)
W84-00361

THE EFFECTS OF TEMPERATURE, INLET POLLUTANT CONCENTRATION, AND MICROORGANISM CONCENTRATION ON THE RATE OF AEROBIC BIOLOGICAL TREATMENT,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. A. Vavilin.
Biotechnology and Bioengineering, Vol 24, No 12, p 2609-2625, December, 1982. 8 Fig, 1 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Aerobic treatment, *Mathematical models, Biomass, Biological treatment, Errors, Graphical methods, Pollution load, Model studies, Retention, Pulp wastes, Dissolved oxygen, Mathematical studies.

Traditional models used to describe aerobic waste treatment processes contain systematic errors which become manifest in broad variations of parameters such as the retention time of sewage liquid in the reactor, the biomass concentration in the reactor, the influent pollutant concentration, temperature, and dissolved oxygen concentration. A generalized model has been proposed for aerobic biological treatment that makes it possible to eliminate these systematic errors and reduce the deviation of experimental from calculated values for effluent pollutant concentration. The generalized mathematical model takes into account the pollutant concentration in the initial and purified liquid waste and the biomass in the unit volume of the reactor. Use of the proposed model is illustrated for sewage waters from paper production being oxidized in a laboratory rotating disk and graphical methods. (Geiger-FRC)
W84-00362

DISSOLVED OXYGEN IN HYDRO PLA DISCHARGE INCREASED BY AERATION,
A. R. Sheppard, and D. E. Miller.
Power Engineering, Vol 10, p 62-65, 1982. 7 Fig Tab.

Descriptors: *Aeration, *Dissolved oxygen, *O genation, Wastewater treatment, Turbines, Pow plants, Water quality.

At the Alabama Power Company there has be successful use of a variation of a concept call draft tube aeration to increase the dissolv oxygen concentration of hydroelectric turbine d charges. This type of aeration uses the hydrau characteristics of the draft tube to produce an flow by means of natural aspiration. In gene these systems involve the positioning of ports b neath the turbine wheel. A simple piping syste vents these ports to the atmosphere, making use the low pressure area usually found below t wheel to provide suction needed to naturally as rate air into the draft tube. The basic concept the system was modified by installing deflect plates upstream of the vent ports to further redu pressure occurring at this location. These plat cause the water to separate from the draft tu wall, creating a Venturi type low pressure area ju downstream of the plates, increasing the amount air a unit can aspirate, and consequently increasi the amount of oxygen that can be added to t water. The design process involves evaluation water quality conditions to establish DO increa target; evaluation of deflector plate/vent port co figurations to optimally locate the ports and dete mine plate configuration to produce maximum su tion pressure; simulation of the draft tube as a g transfer rate and thus the air flow requirement and conceptual design of a piping arrangement provide for the intake and supply of air to the ve ports. This type of system, when applicable, is b far the most economical means of increasing D levels of turbine discharges when compared other methods which include molecular oxygen mechanical aeration. (Baker-FRC)
W84-00371

IN-STREAM REAERATION OFFERS AN A TERNATIVE TO WASTEWATER TREA MENT,
Eder Associates, Locust Valley, NY.
L. J. Eder, and W. J. Cunningham.
Tappi Journal, Vol 65, No 11, p 85-88, Novembe 1982. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Dissolve oxygen, *Pulp and paper industry, Industri wastes, Waste disposal, Wisconsin River, River Biochemical oxygen demand, Reaeration, Ae ation, Cost analysis.

Efforts are underway to amend the discharg permit issued to the Rhinelander Paper Compan in Wisconsin to include waste load allocations fo the maintenance of a 5.0 mg/liter dissolved oxyge standard in the Wisconsin River. The company i currently considering methods for complying wit proposed BCT effluent limitations, tentativel scheduled to become effective in July 1984. Flo diversion of some effluents to their secondar treatment system along with other paper mi modifications should enable their treatment sys tems to produce an effluent within BCT limit Capital costs for reducing the mill's effluent dis charge to meet the most stringent waste load allo cation range from $4,300,000 for spray irrigation t $11,000,000 for secondary treatment and pressur filtration of pulp and paper mill effluents. Operat ing and maintenance costs would increase b $300,000 with spray irrigation and by $515,00 with increased secondary treatment. In-strea reaeration appears to be the least costly method fo meeting waste load allocations. The capital cost o $550,000 for a two-site system is significantly les than the advanced-treatment alternatives. Since th cost of purchased oxygen makes up a significan portion of the total annual costs, the operating cos

d probably be less than $100,000/year. In-
m reaeration could be accomplished in an
onmentally acceptable manner and ensure the
tenance of 5.0 mg/liter DO in the Wisconsin
r. (Baker-FRC)
-00375

SING COOLING WATER IN AN ELEC-
C POWER PLANT,
s and McDonnell, Kansas City, MO.
primary bibliographic entry see Field 3E.
-00386

LAMATION OF WASTEWATER CON-
UENTS BY ION EXCHANGE, PART I -
IEW OF FLOWSHEETS FOR THE PROC-
ES,
Bolto, and L. Pawlowski.
ent and Water Treatment Journal, Vol 23, No
5-58, February, 1983. 5 Fig, 33 Ref.

riptors: *Chromium, *Cyanide, *Metal-finish-
vastes, *Separation techniques, *Wastewater
vation, *Anion exchange, Industrial wastes,
ewater treatment, Waste recovery, Recycling,
xchange.

n recycling metal finishing water to recover
ituents, the economic value of the process
ases with the amount of water recycled. Proc-
conomics depend on the concentration of the
on (the regeneration effluent recovered in the
xchange operation). In treating wastewaters
chrome plating, the process involves separat-
the suspended matter, removing organic
r, and decationizing and deanionizing the
water. An alternative method for the treat-
of chromium rinse water is neutralization
sodium hydroxide, followed by removal of
recipitated heavy metal hydroxides and ad-
ion of chromate anions onto a strongly basic
exchanger. By implementing engineering
ges, a significant improvement is obtained
the use of a counter-current fixed bed system
on a very short column. In the regeneration
anide plating wastewater, a three-column
n consisting of a strongly acidic cation ex-
ger followed by a weakly basic anion ex-
ger and a strongly basic anion exchanger has
successful. The regeneration of the anion
nger is performed with caustic soda in a
er-current manner. Theoretically, recycling
e regeneration effluent is practicable only
the cyanide rinse water, which is separated,
ins only the metals present in the original
(Geiger-FRC)
00392

T IMPRESSIONS OF A NOVEL AER-
N SYSTEM FOR ACTIVATED SLUDGE
NTS,
Hopwood, and L. M. Barnes.
ent and Water Treatment Journal, Vol 23, No
2-65, 67-70, February, 1983. 3 Fig, 8 Tab, 15

riptors: *Aeration, *Model studies, *Contact
ization, *Activated sludge process, Organic
ng, Wastewater treatment, Nitrification, Con-
eds, Suspended solids, Respiration, Activated
e, Biological oxygen demand.

contact stabilization plant at Isleham, which is
f the Water Authority, was modified with a
eration system according to different Ventur-
models to accept a higher organic loading.
a four month trial period, it was noted that a
ved oxygen concentration of over 1 milli-
/liter could be maintained with vigorous
g and aeration. Respiration rate meas-
ents showed that the oxygenation capacity of
rators in a full-scale activated-sludge plant
equal to or better than their previously as-
l performance in clean water. The plant efflu-
ontained an average of 15 milligrams/liter
nded solids and 19 milligrams/liter of biologi-
xygen demand (BOD). BOD removal was
7.6% and nitrification was nearly 50%. The
naceous respiration rate was determined as an
ge of 1.36 kilograms oxygen utilized per kilo-
gram BOD applied. High sludge-growth rates were observed on the order of 0.92 kilograms of sludge produced per kilogram of BOD applied due to organic load and the use of macerated whole sewage. (Geiger-FRC)
W84-00404

TECHNOLOGY FOR THE REMOVAL OF SYNTHETIC ORGANIC COMPOUNDS,
Ontario Ministry of the Environment, Toronto.
N. W. Schmidtke, and S. A. Black.
Effluent and Water Treatment Journal, Vol 23, No 2, p 47-50, 52-54, February, 1983. 7 Fig, 14 Tab.

Descriptors: *Wastewater treatment, *Organic compounds, *Activated carbon, *Separation techniques, Water treatment, Drinking water, Water pollution sources, Waste disposal, Advanced wastewater treatment, Tertiary wastewater treatment.

The problems caused by synthetic organic compounds (SOCs) in water supplies are numerous and are still being assessed. Research is being done to improve the analytical sensitivity required to detect SOCs in water, wastewater and sludges. Nevertheless, the application of any one single technology will not be the answer to any one SOC problem. However, activated carbon treatment will most likely play an important part in the control of SOCs. Technology for the control of SOCs in drinking water supplies is focusing on the enhancement of existing processes and reuse and reformulation options. The application of stringent in-plant process controls along with careful waste disposal selection is the most cost-effective means of ensuring that only minimum quantities of SOCs will escape in process effluents, enter the environment and require further treatment. (Geiger-FRC)
W84-00405

EVALUATION OF BIOMASS AGE IN ACTIVATED SLUDGE PROCESSES,
Rome Univ. (Italy). Cattedra di Principi di Ingegneria Chimica.
M. C. Annesini.
Water, Air, and Soil Pollution, Vol 19, No 1, p 55-61, 1983. 4 Fig, 7 Ref.

Descriptors: *Activated sludge process, *Aging, *Biomass, Wastewater treatment, Sludge, Sludge conditioning, Mathematical equations.

A general formulation is presented for expressing biomass age that may be used regardless of aeration tank set up. In this criterion the biological reaction may be likened to completely mixed reactors operated in series. Expressions for a single-unit reactor have been deduced from the general expression, and these are shown to be equivalent to those reported in the art, and for plug flow reactor. An examination of multi-stage processes without recycle shows that whenever the overall effect of phenomena connected to biomass growth is negative biomass age can be deduced from the volumetric residence times of the single reactors. (Baker-FRC)
W84-00428

TREATMENT OF BLUE CRAB PROCESSING PLANT WASTEWATER USING PHYSICAL, CHEMICAL AND BIOLOGICAL PROCESSES,
Maryland Univ., College Park. Dept. of Agricultural Engineering.
E. L. Geiger, F. W. Wheaton, and R. B. Brinsfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120856, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center Technical Report No 71, August 1983. 142 p, 27 Fig, 17 Tab, 71 Ref, 2 Append. OWRT A-056-MD(1), 14-34-0001-2122.

Descriptors: *Wastewater treatment, *Wastewater analysis, *Effluents, *Processing plants, Chemical coagulation, Foam fractionation, Ultraviolet radiation, Biological wastewater treatment, Sand filters, Activated carbon, Adsorption.

A treatment system for wastewater from a blue crab processing plant consisting of a biological reactor, sand filter and an activated carbon column was evaluated. Various retention times and dilutions of retort effluent were used to assess reduction of dissolved organics and solids following biological treatment. The necessity of utilizing activated carbon adsorption in conjunction with sand filtration to produce an effluent suitable for UV disinfection was evaluated. These tests indicated: (1) 24-hour batch biological treatment of 5% retort effluent resulted in a mean reduction of 88% in biochemical oxygen demand (BOD sub 5), 86% in chemical oxygen demand (COD), and 29% in total suspended solids (TSS) and produced an effluent with a mean UV transmission of 30%; (2) hourly addition of 5% retort effluent to the reactor during the first 8 hours resulted in reduction of 92% in BOD sub 5 and 90% in COD, 23% in TSS and produced an effluent with a UV transmission of 35% after a 24-hour reaction time; (3) biological treatment using intermittent addition of 1% dilution of retort effluent resulted in organic reduction of 99% in BOD sub 5, 92% in COD, 9% in TSS, and produced an effluent with a UV transmission of 72%. The organics and solids concentrations in the 1% intermittent addition system were reduced sufficiently to allow UV treatment without the use of activated carbon adsorption.
W84-00435

DETERMINATION OF ALGAL-BACTERIAL INTERACTIONS IN WASTEWATER TREATMENT LAGOONS,
Northern Arizona Univ., Flagstaff. Dept. of Biology.
H. Speidel, F. Colwell, and D. Blinn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120898. Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Ariz. September 1983. 66 p, 13 Fig, 16 Tab, 65 Ref. OWRT A-113-ARIZ(1), 14-34-0001-2103.

Descriptors: Microbial ecology, *Algal-bacterial interactions, Lagoons, *Wastewater treatment, *Oxidation ponds, Chlorella vulgaris, Escherichia coli, Bacterial survival.

The primary objective of this study was to determine whether algae present in wastewater oxidation ponds either enhance or inhibit the survival of pathogenic or indicator bacteria commonly found in wastewater. Population dynamics were studied for pond isolated axenic algae and bacteria in culture together and alone to note whether interactions may be obvious in terms of cell division or survival. Algal-free filtrates from algal cultures were inoculated with bacteria to assess the need for direct contact of interacting organisms. A variety of bacteria and algae were also grown on double-sided plates to allow diffusion of possible extracellular products. In situ studies involved the suspension of bacteria within dialysis bags followed by placement of bags in wastewater lagoons or separation of bacteria from pond water by cellulose acetate membranes in parabiotic tubes. When cultured in the presence of Chlorella vulgaris, Escherichia coli exhibited an increased rate of dieoff relative to the control or when cultivated with Scenedesmus longus. Growth of unialgal, nonaxenic Scenedesmus sp. on double-sided plates was enhanced when cultivated opposite a Pseudomonas sp. Growth of this same alga was inhibited when other bacteria were established. Results of the cocultures of Chlorella vulgaris-Escherichia coli and double-sided plates suggest that the interactions of selected algae and bacteria occur although these are controlled situations and difficult to compare to the complex conditions of a eutrophic pond. Additionally, the double-sided agar plate offers a new method for rapid screening of potential microbial interactions.
W84-00439

APPLICATION OF REVERSE OSMOSIS TO AUTOMOTIVE ELECTROCOAT PAINT WASTEWATER RECYCLING,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
For primary bibliographic entry see Field 3A.
W84-00460

A CRITICAL REVIEW OF FOULING OF REVERSE OSMOSIS MEMBRANES,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 3A.
W84-00467

UTILIZATION OF WASTE OF HOT WATER FOR DISTILLATION,
Indian Inst. of Tech., New Delhi. Centre of Energy Studies.
For primary bibliographic entry see Field 3A.
W84-00476

RESURRECTION OF DEIGHTON SEWAGE TREATMENT WORKS,
Yorkshire Water Authority (England). Western Div.
C. N. L. Cree.
Water Pollution Control, Vol 82, No 1, p 87-101, 1983. 8 Fig, 2 Ref.

Descriptors: *Sludge disposal, *Rehabilitation, *Industrial wastewater, Wastewater treatment, Deighton Sewage Plant, Huddersfield, *United Kingdom, Sludge digestion, History, Maintenance, Wool wastes.

The Deighton Sewage Treatment Works downstream of Huddersfield on the River Colne, United Kingdom, started with primary sedimentation and sand filtration in 1876. After a series of alterations and additions to accommodate the wastes from the many woolen factories nearby, the sludge treatment facility was declared unrepairable in 1972. The water authority reorganization in 1974 opened the way for improvement of the many deficiencies in the plant: a permanently open inlet control penstock, clogging of the entire system with septic sludge, lack of grit removal, an overflowing sludge tip, constant overflows of untreated sewage into the river, and toxic chemical wastes from industrial dischargers. Some of the problems were solved by improving plant maintenance, replacement of the inoperative penstock, disposal of the humus sludge at sea, removal of excess chemical sludge to a spare bioaeration plant, installation of two sets of vertical bar screens, continuous shift work in the sludge dewatering facility, updating of filter presses, reprofiling the sludge tip, and control of toxic wastewater in influent. (Cassar-FRC)
W84-00479

WHAT MAKES A SLUDGE COLLECTOR DRIVE TICK.,
Envirex, Inc., Waukesha, WI.
E. P. Saffran.
Water/Engineering and Management, Vol 130, No 1, p 24-25, 28, 45, 1983. 1 Tab.

Descriptors: *Sludge, Mechanical equipment, Wastewater treatment, *Wastewater treatment facilities, Drive, Gears.

The most widely used circular collectors are scraper-type clarifiers and thickeners, suction-type sludge removal units, and process combination collectors. In the scraper-type units, scraping blades are attached to a rotating truss. The blades convey the sludge radially to the center of the collector, where it is removed either by a sludge pump or by hydrostatic pressure. The gravity thickener is a scraper-type collector which allows the sludge to settle and thicken. The circular collector becomes an efficient secondary clarifier when its sludge-removal mechanism is modified. A circular collector has either a peripheral drive or a center drive. There are two types of center drives; the full bridge and the half bridge. The gearhead is the heart of the system. In practical, operational terms an underdesigned bearing may cost less than $10 to replace. The job of installing a new one may take less than 3 hr. However, a complete replacement gear will cost several thousand dollars and will take several days to replace. The various parts and elements of the gearhead must be compatible. The design life of the drive, the gears, the bearings and the rotating structure must all be balanced to achieve the specified performance over the specified lifespan. The proper balance can reduce capital investment and operating costs. It can help ensure the high dependability that is needed in systems which treat municipal and industrial wastewater. (Baker-FRC)
W84-00484

INFLOW DISTRIBUTION IN WASTEWATER COLLECTION SYSTEMS,
RJN Environmental Associates, Inc., Wheaton, IL.
A. J. Hollenbeck, and R. J. Nogal.
Water/Engineering and Management, Vol 130, No 1, p 30-33, 1983. 2 Fig, 7 Tab, 4 Ref.

Descriptors: *Wastewater collection, *Flow characteristics, *Sewer systems, Infiltration, Inflow, Monitoring, Measuring instruments.

Analysis of actual field-verified inflow data for several sewer system evaluation surveys points to certain conclusions regarding the inflow component of infiltration and inflow (I/I) sources in sanitary sewer systems. Inflow appears in general not to be highly concentrated in small parts of a collection system, but rather evenly distributed. It is independent of the flow monitoring interval used to isolate inflow sources. Elimination of large parts of a sanitary sewer system from field survey activities could result in not identifying up to 50% of the largest inflow sources. Inflow reduction is proportional to the extent of the field survey work performed. Rehabilitation by priority can be part of an annual operation and maintenance program. The identification and reduction of excessive flow in a sewer system is complex and is just beginning to be understood by the technical community. It would be inappropriate to abandon the program or search for shortcuts that will not accomplish the stated goals and desired objectives of the I/I reduction and rehabilitation efforts. (Baker-FRC)
W84-00485

TRAINING MAKES ENFORCEMENT EASIER,
Minnesota Pollution Control Agency, Roseville.
G. A. Erickson, and M. W. Herman.
Water/Engineering and Management, Vol 129, No 12, p 24-26, 1982. 4 Tab.

Descriptors: *Wastewater treatment, *Training, *Management, Decision making, Education, Regulations, Enforcement.

The Minnesota Pollution Control Agency was established in 1967 and given authority to administer and enforce all laws relating to water, air and land pollution within the state. Enforcement was used as the main tool in achieving compliance with prescribed standards. To aid in personnel training the agency implemented an operator assistance program in 1976. Its principal objective was to train operators in process control. This would improve their skills and enhance their ability to produce consistently high quality effluent. Selection of a plant for an assistance project basically involves two situations. The facility may be having operational problems causing it to be in noncompliance, or it may currently be in compliance but is approaching the point of being in violation because of difficulties. Since the onset of the program 30 major projects have been completed. Of those 30, four were not successful. Two of these were because of uncooperative operating or municipal officials, while the other two were because the facility would not show any significant improvement in effluent quality. Two thirds of the completed projects involved activated sludge plants in which the major problem was lack of a process control program or interpretation of one already in existence. The remaining third of the projects were carried out at trickling filter plants and controlled discharge stabilization ponds. The time for project completion varied from a minimum of five months to a maximum of 30 months, with an average time of 14 months per project. (Baker-FRC)
W84-00487

ESTIMATING WASTE ACTIVATED SLUDGE,
Clemson Univ., SC.
L. G. Rich.
Water/Engineering and Management, Vol 129, No 12, p 35, 1982. 1 Tab.

Descriptors: *Estimating equations, *Activ sludge process, *Wastewater treatment, Mathe ical equations, Suspended solids, Estimating, F rates.

The estimating of waste activated sludge quant has long been neglected in the wastewater t ment field. Two quantities are of basic importa the daily production rates of total solids an biodegradable solids. Equations are derived situations in which no pretreatment is given to wastewater. In cases where pretreatment is fered, the characteristics of the pretre wastewater are used in place of those of the fluent wastewater. The concentration of solids remaining in the wastewater after 30 aeration at room temperature can be determine a batch mode using an Imhoff cone fitted aeration tubing. In making the determination important to replace the water that evapor from the system on a daily basis. Aeration sh be conducted in the dark to suppress algal gro The volumetric flow rate at which waste activ sludge is processed through a sludge treatm train is also of considerable importance in de The concentration of solids in waste activ sludge withdrawn from the underflow of the ondary clarifier will normally vary between 7 and 10,000 mg/liter. (Baker-FRC)
W84-00489

SOLUTION TO ODOR PROBLEM GIVES EXPECTED SAVINGS,
Saratoga County Sewer District No. 1, Mecha ville, NY.
D. J. Rudolph.
Water/Engineering and Management, Vol 129, 12, p 28-29, 1982.

Descriptors: *Wastewater treatment, *Odor trol, *Permanganate, Hydrogen sulfide, Sulf acid, Corrosion, Odors, Sewer systems, Cost an sis, Sludge dewatering.

The Saratoga county wastewater treatment p was seeking a solution to an odor problem. Du a study of the system district personnel discov that the chemical, potassium permanganate, only took care of the odor nuisance but also duced unexpected cost savings in the sludge de tering department. The odor problem had most prevalent at three pumping stations range in load from about 500,000 gpd dow about 60,000 gpd. Hydrogen sulfide concentrat in the atmosphere during the summer were gre than 100 ppm and varied down to 50-60 ppm times of light usage. Not only was the od problem, but the oxidation of hydrogen sulfid the atmosphere to sulfuric acid caused corrosio mild steel equipment and copper contacts of e trical systems. The permanganate is now adde the three pumping stations using dry fee equipped with slurry modules. The resul KMnO4 solution is metered into the wet w directly to the influent sewage. Average dosag about 20-25 lb/mil gal, and total consumption the collection system amounts to about 125 lb/ The permanganate reacts very quickly with hy gen sulfide, and very little gas is now release the atmosphere from the cascading sewage. T processing savings are truly significant. It use cost $209 to process a dry ton of cake. Today cost is $65. (Baker-FRC)
W84-00491

STUDIES ON ALKALINE EARTH SULFIT III(1). TRANSIENT SOLUBILITIES A PHASE CHANGES OF CALCIUM SULFITE SEAWATER,
For primary bibliographic entry see Field 3A.
W84-00504

THE BOWHOUSE SEWERAGE AND SEWA DISPOSAL SCHEME OF FIFE REGION COUNCIL,
K. C. Wilson.
Water Pollution Control, Vol 82, No 1, p 42 1983. 2 Fig, 2 Tab, 11 Ref.

ɔtors: *Oxidation ditches, *Ditches, water treatment, Storage tanks, Bowhouse Treatment Plant, *Scotland.

g sewage treatment works at three towns in d (Ladybank, Auchtermuchty, and Falk- were replaced with an oxidation ditch centrally located at Bowhouse. The ditch y is 1396 cu m; retention time, 27.65 hours. ystem also contains settlement tanks and , activated sludge storage tanks, and septic idge storage tanks. Final effluent since the uns has had < 10 mg per liter BOD and < per liter suspended solids. (Cassar-FRC) 511

USE OF OXYGEN TO UPRATE THE MENT CAPACITY OF A CONVEN- L SURFACE-AERATION PLANT AT ENHURST (BOURNEMOUTH) GE-TREATMENT WORKS,
inson, R. A. Varley, and A. R. Kimber.
Pollution Control, Vol 82, No 1, p 49-51, Tab.

ɔtors: *Oxygen, *Nitrification, *Odor con- astewater treatment, Holdenhurst Sewage ent Works, *United Kingdom, Oxidation, n.

ions and additional tables are presented for ve titled paper, published by the same au- Water Pollution Control, Vol. 81, No. 3, 1. Liquid oxygen was used at the Holden- ewage Treatment Plant, United Kingdom, te overloaded nitrification and carbona- eration lanes and to suppress odors. This omplished by either side stream, in-pocket, t injection, depending on the location. The treatment efficiency was 1.08 kg 02 sup- r kg BOD removed, an improvement from lier 1.46 kg per kg value. (Cassar-FRC) 512

OZONATION FOR THE TREATMENT WAGE-TREATMENT WORKS ODOURS,
erson, and G. F. Greaves.
Pollution Control, Vol 82, No 1, p 18-20, Fig.

tors: *Odor control, *Ozonation, *Sewage idation, Chlorination, *Wastewater treat- ulfides.

r control program in a sewage treatment hould include adequate ventilation, usually air changes per hour, close-fitting tank and treatment of odorous gases. Sewage rise from some or all of the following nds: hydrogen sulfide, methyl mercaptans, sulfides, amines, fatty acids, alcohols, and Treatment methods such as acid and alka- ubbing and chlorine oxidation usually do inate all the odorous compounds. Howev- ation will destroy all the above compounds xpected pH and temperature variations. FRC) 513

IOENERGY PROCESS--AN OVERVIEW,
Zippon
Pollution Control, Vol 82, No 1, p 29-36, Fig, 3 Tab.

tors: *Anaerobic conditions, *Industrial ater, *Contact process, *Wastewater treat- Bioenergy process, Activated sludge proc- mass, Settling tanks, Methane.

energy process, a variant of the anerobic process, was created in 1974. A thermal pplied to the anaerobic biomass just prior to the settling tank prevents gassing which y occurs at this step. This approach pro- igh separation efficiency. Effluents of 1000 0 mg BOD per liter may be effectively Compared with the activated sludge proc- Bioenergy process has reactors half as equires only 1/7 the energy, has settlers s large, produces 1/10 the sludge, and gen- erates 0.5 tons of fuel per ton BOD applied. In a series of industrial wastewaters treated, BOD removal was 90-99%; COD removal, 83-98%. The Bioenergy process overcame high sulfate concentrations, trace element deficiencies, high ionic strength, nutrient deficiencies and overloads, high concentrations of nonbiodegradable solids, low alkalinity, and salt crystallization in the heat exchangers. (Cassar-FRC)
W84-00514

HYDRAULIC AND GEOLOGICAL PROBLEMS OVERCOME AT BOBCAYGEON'S WATER AND SEWAGE TREATMENT PLANTS,
For primary bibliographic entry see Field 5F.
W84-00515

TESTS ON AERATORS: CONCLUSIONS DRAWN FROM 500 CLEAN WATER TESTS CONDUCTED IN 200 DIFFERENT SEWAGE TREATMENT PLANTS--II. DATA INTERPRETATION (ESSAIS D'AERATEURS: ENSEIGEMENTS TIRES DE 500 ESSAIS EN EAU CLAIRE EFFECTUES DANS 200 STATIONS D'EPURATION DIFFERENTES-II. RESULTATS),
Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Paris (France).
A. Heduit, and Y. Racault.
Water Research, Vol 17, No 3, p 289-297, March, 1983. 6 Fig, 6 Tab, 4 Ref.

Descriptors: *Aeration, *Oxygenation, *Performance evaluation, *Wastewater treatment, Bubbles, Error analysis, *France.

Aerator tests at sewage treatment plants in France revealed that oxygenation capacities predicted by the manufacturers were close to observed values. In a well mixed tank, using the correct procedure, the relative error in measuring specific oxygen input was 5%. Under less favorable operating conditions, the error was 10%. Average specific oxygen inputs in clean water using different aeration systems ranged from 0.6 to 2.5 kg 02 per kWh. Highest values were obtained with fine bubbles and mechanical agitation. Relationships between oxygenation capacity and specific power consumption are plotted. (Cassar-FRC)
W84-00516

THE CULTIVATION OF ALGAE USING WASTE WATER FROM FEEDLOTS,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
A. J. H. Pieterse, J. LeRoux, and D. F. Toerien.
Water SA, Vol 8, No 4, p 202-207, 1982. 7 Fig, 5 Tab, 41 Ref.

Descriptors: *Animal wastes, *Algal growth, *Waste disposal, Aquaculture, Algae, Water pollution control, Water pollution sources, Wastewater treatment, Ponding, Fecal contamination, Bacteria, Cattle feedlots, *Feedlot runoff.

The cultivation of algae in ponded wastewater from a cattle feedlot is described. Treatment is aimed at organic and inorganic wastes produced by animals such as cattle which, for economic and other reasons, are kept in confinement units. Massive amounts of waste material consisting of urine and feces are produced in a concentrated point-source form in these confinement units. Waste materials are usually removed by wash or flush water, representing a major source of environmental pollution with significant health and aesthetic consequences. The largest cattle feedlot system in South Africa contains approximately 30,000 animals, producing waste equivalent to that of a city of 180,000 to 300,000 people. As a matter of urgency consideration must be given in South Africa to the development and application of integrated livestock waste treatment production systems to reduce this pollution. In this study an annual average algal production rate of 10 g/sq m/day of dried algal material was achieved, while a reduction in inorganic nitrogen and phosphorus concentrations in excess of 90% was maintained in a high rate algal pond supplied with feedlot effluent. These results indicate that the algal pond concept can be used efficiently under South African conditions; further study is needed to optimize such a treatment/production system. (Baker-FRC)
W84-00525

THE DESIGN AND CONSTRUCTION OF SPRINGFIELD SEWAGE-TREATMENT WORKS,
Fife Regional Council (Scotland).
J. G. Moore.
Water Pollution Control, Vol 82, No 1, p 37-41, 1983. 1 Fig, 2 Tab.

Descriptors: *Animal wastes, *Municipal wastewater, *Sludge disposal, Wastewater treatment, Springfield, *Scotland, Dewatering, Farm wastes, Filters, Sludge digestion, Land application.

A sewage treatment works was built for the Springfield, Scotland, region, population 7000, which included several sources of problem wastes: a hospital, a college farm, a piggery, an abattoir, and an oatmeal factory. The system contained primary settlement and storm tanks, percolating filters, humus tanks, and sludge holding tanks. A filter belt press was chosen for sludge dewatering. Most disposal of sludge is on farmland; some sludge is being mixed with fly ash for landscaping fly ash lagoons. The new treatment system replaced an overloaded and poorly serviced settlement tank and direct discharge of the industrial effluents to the River Eden. (Cassar-FRC)
W84-00529

WATER, THE ESSENCE OF LIFE - AN INTERNATIONAL CONGRESS ON DESALINATION AND WATER REUSE,
CH2M Hill Southeast, Inc., Gainesville, FL.
For primary bibliographic entry see Field 3A.
W84-00532

AN OVERVIEW OF DIGESTION PROCESSES,
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
W. A. Pretorius.
Water Science and Technology, Vol 15, No 1, p 1-6, 1983. 3 Fig, 13 Ref.

Descriptors: *Digestion, *Methane bacteria, *Anaerobic digestion, *Wastewater treatment, Sludge digestion, Fermentation, Bacteria, Acetic acid, Fatty acids.

Anaerobic digestion of concentrated wastes relies on the highly specialized methane bacteria to convert organic matter to methane. The process has some disadvantages: the complexity of the bacterial mechanisms and resulting difficulty in process control, low growth rate of bacteria at ambient temperatures, and the necessity for further treatment of effluent before discharge. Methane bacteria include representatives of nearly all basic forms of bacteria. They have in common the ability to oxidize molecular hydrogen to methane in the absence of oxygen. About 70% of the methane formed proceeds through an acetic acid intermediate step. It is possible that methanogenesis proceeds through a dual- or multi-step mechanism involving several types of bacteria and chemical reactions, such as hydrolysis, fermentation, acetate decarboxylation, and methanogenesis. Basic designs of anaerobic digestors include conventional (for sewage sludges and animal wastes), contact process (dilute and soluble biodegradable wastes from such places as meat packing plants), filters (for acetic acid-containing wastewaters), and upflow sludge blanket reactor (for dilute starchy washwaters). (Cassar-FRC)
W84-00552

ENERGY OPTIMIZATION IN SEWAGE AND SLUDGE TREATMENT,
Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Water Science and Technology, Vol 15, No 1, p 103-114, 1983. 11 Fig, 4 Tab, 2 Ref.

Descriptors: *Sludge digestion, *Energy, *Activated sludge process, *Wastewater treatment, Incineration, Sludge disposal, Costs, Digestion.

The energy requirements of three wastewater treatment systems in Germany are described. Present BOD-population equivalents and energy demands are as follows: Bochum-Olbachtal, 150,000 and 14.4 million kWh per year; Hagen, 270,000 and 6.1 million kWh per year; and Duisburg (proposed plant), 510,000 and 4 million kWh per year. Bochum consists of a conventional activated sludge plant, polishing lagoons, dewatering and incineration of primary sludge, and digestion and incineration of waste activated sludge. Incineration requires 65.5% of the energy used at the plant. The Hagen system is comprised of primary sedimentation, activated sludge, sludge dewatering, and sludge dumping at a 45% solids content. About 75% of the energy used at Hagen is consumed in the activated sludge process and the trickling filters. The proposed Duisburg-Kasserfeld plant will use diffused air activated sludge treatment with sludge thickening, dewatering, and dumping. Diffused aeration will require 51% and other biological treatment 18% of the energy. (Cassar-FRC)
W84-00553

EFFLUENT TREATMENT AND PROTEIN RECOVERY IN EAST ANGLIA.
Water Services, Vol 86, No 1041, p 536-7, 1982. 2 Fig.

Descriptors: *Wastewater treatment, *Food processing wastes, *Wastewater treatment facilities, *Poultry, East Anglia, Protein recovery, Industrial wastes.

Primary considerations in designing a suitable plant for handling an effluent with a COD of almost 4000 mg/liter and a suspended solids content of 1200 mg/liter, apart from meeting the effluent standards, were the availability of space and the minimization of sludge for off-site disposal. Wastewater is collected in an underground sump and pumped by submersible pumps to a screen mounted above a circular balance tank. Wastewater is then pumped to a circular dissolved air flotation tank constructed in glass reinforced plastic; in line to the flotation tank a specific protein precipitant, lignosulfonate, is added. The pH is reduced to 3 by the addition of sulfuric acid. A fraction of the wastewater is diverted from the pipeline to the flotation tank, and part is saturated with air at five atmospheres pressure. The air dispersion water rejoins the main flow at the inlet to the flotation tank, where microscopic air bubbles are precipitated. These adhere to thee protein/fat flocs and carry them to the surface of the flotation tank, where they are removed by a rotating suction arm. The flotated sludge has a total solids concentration of about 10%. The plant occupies a total area of about 300 sq m and can be operated by one person on a part time basis. (Baker-FRC)
W84-00559

CONTROL AND AUTOMATION SYSTEM FOR WITNEY SEWAGE TREATMENT WORKS,
B. E. Marsh.
Water Services, Vol 86, No 1042, p 586-588, 1982. 2 Fig.

Descriptors: *Wastewater treatment facilities, *Automation, *Data acquisition, Instrumentation, Witney Sewage Treatment Works, Thames Water Authority, Computers, *England.

The Wesdac Supervisory Control and Data Acquisition system to be supplied to meet the specified requirements of the Thames Water, consisting of a conventional Wesdac 6 control center and 10 advanced technology outstations, is described. The total modernization of the Western Division of the Thames Water Authority was undertaken with the objective of increasing its throughput from 3700 to 7800 cubic meters/day. Although it was built on the site of an existing sewage treatment works, only the primary sedimentation tanks were retained in changing the process from filter beds to activated sludge. The final phase of the scheme will be installation of instrumentation, control and automation systems providing the following functions: process controllers dedicated to specific items of plant in each of the primary and secondary treatment areas; a central computer coordinating all local controller and centralizing all plant process measurements; visual display terminals distributing the relevant level of process information to operational and management staff; and the facility as a whole acting as a proving ground for computer based systems for the management of sewage treatment processes and providing instrumentation evaluation facilities in conjunction with the Water Research Center. The flexibility of the intelligent outstations enables a wide range of system functions to be implemented: interfacing to new or existing instrumentation, scanning analog and digital data from the plant into a data base held in the outstation, generating local control output commands for the area of plant under its control, and controlling the flow balancing and aeration areas. It is possible to expand the outstation database to include the facility to hold derived analog and digital data. (Baker-FRC)
W84-00562

ADVANCES IN THE TREATMENT OF LIQUID-BORNE SOLID WASTE.
Water Services, Vol 87, No 1043, p 25-26, January, 1983.

Descriptors: *Solid wastes, *Shredders, Waste treatment, *Wastewater treatment, Mono Muncher, Equipment.

The Mono Muncher is effective in macerating solid debris entering sewage treatment plants. This low-speed disintegrator consists of two parallel, contra-rotating shafts with opposed intermeshing teeth set on cutter discs. The shredding action efficiently reduces nylon, timber, plastic, rags, and metal cans. An exceptionally large object will cause the cutters to reverse in an effort to clear the blockage. If this fails, the system shuts down automatically. Energy consumption per cu m of sludge is 0.01-0.02 kW compared with 0.2-0.44 kW for conventional macerators. The Muncher is especially useful in small plants, for which screens are impractical. Pipeline, channel, and submersible models are available. (Cassar-FRC)
W84-00564

DISCUSSION OF: ROLE OF ADSORPTION IN BIOLOGICAL EXTENDED ACTIVATED CARBON COLUMNS, AND AUTHOR'S RESPONSE,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittman, S. J. Randtke, J. D. Lowry, and C. E. Burkhead.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 512-514, April, 1981. 2 Tab, 7 Ref.

Descriptors: Secondary wastewater treatment, *Activated carbon, *Water treatment, *Wastewater treatment, Adsorption, Potable water.

Comments are presented on the above titled paper by J. D. Lowry and C. C. Burkhead, published in Journal of the Water Pollution Control Federation, Vol. 52, p 389, 1980. Although the discussors agree that adsorption of organics on activated carbon does not enhance biological activity when substrate concentrations are high and oxygen is limiting, they state that the paper does not prove that the opposite case (low substrate concentrations or oxygen not limiting) is true. Therefore, the conclusions cannot be extrapolated to the activated carbon treatment of well-treated secondary effluent or potable water supplies. The author responds that a closer review of his work would indicate that the work is intended only for application to the secondary level of treatment. He cites a reference which concludes that the higher bacterial colony counts on activated carbon are not due to adsorption of organic compounds but to the larger surface area per unit volume of media as compared with nonactivated carbon or sand. (Cassar-FRC)
W84-00570

HEALTH ASPECTS OF WASTEWATER AEROSOLS,
Health Effects Research Lab., Cincinnati, O
H. R. Pahren, and W. Jakubowski.
Water Science and Technology, Vol 13, No 1091-1096, 1981.

Descriptors: *Aerosols, *Public health, *M ganisms, Wastewater pollution, Air pollutio demiology, Viruses, Bacteria, Pathogens, bacteria, Path of pollutants.

Investigations sponsored by the EPA revea adverse health effects from wastewater aero persons living or working near wastewate ment plants. Two studies were retrospectiv years of data on the respiratory and gastroin illnesses of persons living within 600 mete sewage plant at Tecumseh, Michigan, and ness rates of elementary school students playground was 50 meters from the aerated basin of a treatment plant. Epidemiological were as follows: 4200 persons living near 64,000 cu meters per day activated sludge p Illinois were questioned regarding illness health status, and clinical specimens from 2 sons were examined, (2) a group of 2378 p and a group of wastewater plant operators million cu meters per day treatment plant in go were studied, and (3) newly employed ac sludge plant workers and controls in C Cincinnati, and Memphis were evaluated tailed medical tests. Although viable micro isms were detected in air near the treatment comparisons of illness rates and health st exposed persons were not statistically di from control groups with the exception of increase in mild gastrointestinal illnesses in rienced sewage plant workers during the fi months of employment. Several reasons f lack of statistical differences in illness ra suggested, including exposure levels belo minimum infective dose, respiratory expos enteric microorganisms, and nonspecific imm (Cassar-FRC)
W84-00591

SHORT-TERM LOW AS WELL AS HIGH PERATURE OPERATION OF AN MSF P USING BELGARD EVN AS A SCALE TROL ADDITIVE,
University of Petroleum and Minerals, D (Saudi Arabia). Research Inst.
F. H. Butt, and A. H. Bou-Hassan.
Desalination, Vol 42, No 1, July 1982, p 7 Tab, 4 Fig, 2 Ref.

Descriptors: *Desalination, *Multistage *Scaling, Belgard EVN, Distillation.

During a 40-day low temperature trial, conc in 1979 using 2.0 ppm of Belgard EVN, the ranged between 10.9 and 9.9 as against the value of 8.0, while the heater fouling facto rose gradually from 0.00002 to 0.00007 sq C/W. A polyphosphate trial, carried out i on the same MSF plant, showed the rate of f of heater tubes to be four times that durin Belgard EVN trial. During the polyphospha eration, the heater FF had in the same climbed from 0.00018 to 0.00070 sq m deg C/ 1980, the top brine temperature of the uni progressively increased from 87.8 to 104.4C, increasing the Belgard EVN dosage from 2.5 ppm. The GOR increased from 8 to 9 up to brine temperature of 98.9C and then declin about 7.7. The heater FF increased gradually 0.00010 to 0.00019 sq m deg C/W.
W84-00619

CROSS-CURRENT FLOTATION FOR M REMOVAL FROM PLATING WASTES,
Rhode Island Univ., Kingston. Dept. of Che Engineering.
S. M. Barnett, F. J. DeLuise, and E. Nir.
Available from the National Technical Inform Service, Springfield, VA 22161 as PB84-1 Price codes: A02 in paper copy, A01 in micro Water Resources Center Technical Report N September 1983. 11 p, 3 Tab, 11 Ref. OWR 077-RI(1), 13-34-0001-2142.

iptors: *Foam separation, *Flotation, water treatment, *Metal-finishing wastes, metals, Chromium, Zinc, Nickel, Lead.

countercurrent flotation pilot plants have shown to be effective and economical in ing metals such as cobalt, copper, lead, zinc on by means of various precipitate flotation ques, many plating facilities have troughs or horizontal conduits which would make flota- nore economically attractive if these existing els could be adapted for such use. The pur- of this study was to investigate the feasibility osscurrent precipitate flotation for these ns. The metals investigated were copper, and lead. The most important trend found in sults is that the shorter trough more effec- removes metals by precipitate flotation for a pH and given flow rates than the longer n. Thus, the horizontal flotation process l be done over a minimum length to avoid sized enrichment of the water due to foam age.
00640

TU AND ON-SITE BIODEGRADATION DUSTRIAL LANDFILL LEACHATE,
rs - The State Univ., New Brunswick, NJ. of Chemical and Biochemical Engineering. imary bibliographic entry see Field 5E.
00686

Ultimate Disposal Of Wastes

MUNITY PLANNING FOR LAND APPLI- ON,
gia Univ., Athens. School of Environmental n.
Ferguson.
cle, Vol 23, No 5, p 45-49, 1982. 6 Fig, 2 5 Ref.

iptors: *Land disposal, *Water reuse, *Envi- ntal effects, Heavy metals, Pennsylvania, ium, Plant growth, Crop yield, Irrigation, supply development, Design criteria.

iving filter' program begun in 1963 at Penn- ia State University is one of the earliest entatives of land application systems. The m is currently being converted from a small, mental scale to a full scale. The success of ing filter system has been due partly to the al relationship of the system to the commu- serves, the region where it is located, and tural environment in which it operates. The ltural valley of the area is underlain with one and dolomite placed with geologic faults and forested sandstone mountains. In nter of the valley is a low ridge underlain by sandy dolomites. The valley is drained by groundwater flow than by surface s. The proper location for the land applica- te was determined to be on this low ridge in nter of the valley. Here the deep, sandy al soils were very permeable and had a hum- topography. The treated effluent is forced pressure pipe leading from the treatment four miles up to an elevation of about 200 the fields and forests that had been selected land application site. The effluent is distrib- nder pressure by means of a system of main ateral pipes and control valves to evenly l spray heads. The living filter program has led an improved environment for growing crops. Land moisture has been increased and of forage and timber products have helped uce the net costs of sewage disposal. In the of increased buildup of heavy metals, the sed amount of fast-growing irrigated plants ed cadmium from the soil at very rapid There appeared to be no problem with other accumulating either. (Baker-FRC)
00367

ISLAND DEWATERING 100% TMP GE, BURNING IN BOILER,
e (J.E.) Co., Research Triangle Park, NC. Hewitt, and R. Ellis.
Pulp and Paper, Vol 57, No 3, p 96-99, March, 1983. 4 Tab.

Descriptors: *Pulp and paper industry, *Sludge thickening, *Dewatering, Incineration, Bear Island Paper Company, Doswell, Virginia, Sludge conditioning, Economic aspects, Vacuum filters, Filters, Centrifugation, Polymers, Hydrasieve, Sludge drying.

The 100% thermomechanical pulp sludge at the Bear Island Paper Company, Doswell, Virginia, is treated with a Hydrasieve and belt filter presses before being mixed with bark and incinerated. This difficult-to-dewater sludge (1.5-2.0% solids) is high in fines content, of which 75-85% passes through a No. 200 sieve. Of the thickening processes tested during development of the sludge treatment program, centrifuge and rotary screen thickener were acceptable, but dissolved air flotation was not. Although centrifuges, diaphragm presses, and V- presses were also effective for dewatering sludge, they were not as economical as the belt filter presses. Operating experience since July 1981 showed that settling and underflow conditions were improved by maintaining a pH of 9.0-9.5 in the primary clarifier feed, adding residual polymer from the press effluent, and slowing down the clarifier rake speed by 60%. Polymer dosage varies with the sludge consistency from 10 to 20 pounds per ton of dewatered sludge. The Hydrasieve produces a 25-33% filter cake which is further dewatered by the belt filter presses. However, the overall cake dryness is limited by serious clogging on the belts. Additional dewatering equipment will be required to produce a filter cake of 35-45%, capable of direct firing of the boiler without added bark. (Cassar-FRC)
W84-00389

THE MOVEMENT OF METALS APPLIED TO SOILS IN SEWAGE EFFLUENT,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5B.
W84-00429

RESURRECTION OF DEIGHTON SEWAGE TREATMENT WORKS,
Yorkshire Water Authority (England). Western Div.
For primary bibliographic entry see Field 5D.
W84-00479

SECOND MEMORANDUM OF EVIDENCE TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION.
Water Pollution Control, Vol 82, No 1, p 123-125, 1983.

Descriptors: *Water quality standards, *Ocean dumping, *Sludge disposal, Acid rain, Estuaries, Monitoring, Fate of pollutants, *United Kingdom.

On invitation from the Royal Commission on Environmental Pollution, evidence on water quality subjects was gathered. Remedial measures for acid rain must be designed to avoid local pollution of water, for example, proper disposal of spent stack gas scrubbing substances. Although international opinion on disposal of sewage sludge at sea has become more negative, the Institute favors a controlled and well-monitored ocean dumping program. Full implementation of the Control of Pollution Act of 1974 will be a problem for estuaries for which little historical data is available to derive mathematical models of mixing and dispersion. (Cassar-FRC)
W84-00530

AN OVERVIEW OF DIGESTION PROCESSES,
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W84-00552

ENERGY OPTIMIZATION IN SEWAGE AND SLUDGE TREATMENT,
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W84-00553

RECENT DEVELOPMENTS IN SLUDGE CONDITIONING AND DEWATERING,
Omnium de Traitement et Valorisation, Courbevoie (France).
J. C. Cornier, L. Divet, and H. Moreaud.
Water Science and Technology, Vol 15, No 1, p 49-58, 1983. 6 Fig, 3 Tab.

Descriptors: *Sludge conditioning, *Sludge digestion, *Dewatering, Polymers, Polyelectrolytes, Energy, Centrifugation, Anaerobic digestion, Digestion, Incineration.

In France the current objectives in sludge treatment are to minimize chemical and energy costs, facilitate maintenance of the plant, and promote sludge utilization. Replacement of inorganic conditioners such as ferric chloride and lime with polymers has increased filtration rates and simplified maintenance by eliminating lime storage facilities, lime scaling of equipment, and corrosion from ferric chloride. Separate thickening for primary sludges and biologically treated sludges results in sludges of 5-8% solids content vs. the 3-4% seen in some plants. Experiments showed that thermal digestion, incineration of centrifuged sludge, and digestion of the liquors was not only self-supporting with respect to energy but produced a considerable surplus of heat and gas. (Cassar-FRC)
W84-00554

SOUTH AFRICAN PRACTICE IN LAND DISPOSAL OF SLUDGE, INCLUDING LEGISLATION AND HEALTH ASPECTS--AN OVERVIEW,
Department of Health and Welfare, Pretoria (South Africa).
G. Oberholster.
Water Science and Technology, Vol 15, No 1, p 151-155, 1983. 5 Ref.

Descriptors: *Land disposal, *Agriculture, *Sludge disposal, *South Africa, Soil amendments, Water pollution prevention, Legislation, Pathogens, Fate of pollutants, Legal aspects, Regulations, Sludge utilization.

In South Africa sewage and sludge disposal practices vary widely throughout the country. Cities have sophisticated treatment systems or dispose of raw sewage in the sea. Rural areas use pit latrines and other simple systems. Data on sludge production is available only for Cape Province. Here 205 tons of sludge per day are produced, 76.4% from biological filters and activated sludge plants. Of the total sludge production, 64.6% is disposed on land, 89% of this for agriculture. Growers are not enthusiastic about land disposal except in sandy soils which benefit from a soil conditioner. South Africa is concerned with the hazards produced by sludge disposal, especially the pathogen, Ascaris. Legal provisions are available for controlling sludge disposal and preventing water pollution from this source, but to date no regulations have been made. Reasons for this are: (1) the paucity of scientific knowledge, especially on a local basis, and (2) a preference for slowly evolving guidelines, rather than strict statutes. Raw or primary sludge may not be used for agriculture, except as a compost supplement. Secondary sludge is limited to crops not eaten raw by humans and to some parks and sports fields under development. Tertiary sludge application is less restricted; sludge treated with advanced methods may be used anywhere with proper monitoring. (Cassar-FRC)
W84-00555

THE USE OF SEWAGE SLUDGE IN AGRICULTURE,
Water Research Centre, Stevenage (England).
E. G. Coker.
Water Science and Technology, Vol 15, No 1, p 195-208, 1983. 2 Tab, 52 Ref.

Descriptors: *Land disposal, *Sludge disposal, Agriculture, Land reclamation, Reviews, Soil amend-

ments, Soil properties, Water pollution prevention, Nutrients, Fertilizers, Nitrogen, Phosphorus, Organic matter, Sludge utilization, Fate of pollutants, Pathogens, Heavy metals, Metals, Toxicity.

The use of sewage sludge in agriculture is reviewed. Prior to the 1960's there was little enthusiasm for applying sludge to farm soils and little perception of its benefits. The major components in sludge useful in agriculture are organic matter, nitrogen, and phosphorus. The amount and chemical form of nitrogen and phosphorus varies with the type of sludge. Phosphorus content of the sludge can reach 18% as P205 in treatment processes designed to remove phosphorus. Use of sludge in agriculture is limited by the danger of polluting surface and groundwater with N, P, or pathogens. Guidelines for sludge application rates have been developed by countries according to their attitudes toward pollution. Among the trace elements which may be toxic at high accumulations are Zn, Cu, and Ni (phytotoxic) and Cd, Cu, Mo, Se, As, F, Pb, and Cr (harmful to humans and farm animals). Pathogens of concern are Ascaris, Salmonella in cattle yards, and human-beef tapeworm. Contact with pathogens is minimized by lagooning of sludge for 2 years, mesophilic anaerobic digestion of sludge, mechanical cultivation of fields, prevention of grazing on sludged fields for 3 weeks after sludge application, and choosing crops more suitable for growing with sludge (grains, fodder, and grasses). Sludge is also useful in reclaiming derelict land, such as waste tips, pits, and quarries, and in afforestation. (Cassar-FRC)
W84-00556

SEA DISPOSAL OF SLUDGE--THE U. K. EXPERIENCE,
Thames Water Authority, London (England).
H. Fish.
Water Science and Technology, Vol 15, No 1, p 77-87, 1983. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *United Kingdom, International agreements, Monitoring, Water pollution effects.

Sludge disposal to the sea began on a large scale in the United Kingdom in 1889. Control measures were instituted in the 1960's; full licensing control, in 1974 (Dumping at Sea Act). Each year 10.5 million wet tons (300,000 dry tons) of sludge is disposed of in the sea, 95% by ship and the remainder by pipelines. The outer Thames Estuary receives 45% of the sludge. Present operations of sea disposal of sludge do not seriously affect the marine environment. Nitrogen and phosphorus levels at dump sites are sometimes twice that of unaffected water but are still much less than in the Mersey Estuary, heavily polluted with industrial discharges. Several mechanisms control sea disposal; international conventions (Oslo and London) and supervision by the Minister for Agriculture, Fisheries and Food. Metals concentrations in sewage sludge have dropped dramatically since 1974 as a result of the water authorities' monitoring of industrial wastewaters entering the treatment systems. It is recommended that sea disposal of sewage sludge be continued and expanded in the United Kingdom where economically and environmentally appropriate. (Cassar-FRC)
W84-00557

AGRICULTURAL UTILIZATION OF SEWAGE SLUDGE IN THE U.K.,
Anglian Water Authority, Huntingdon (England).
P. J. Matthews.
Water Science and Technology, Vol 15, No 1, p 135-149, 1983. 5 Tab, 10 Ref.

Descriptors: *Sludge disposal, *Land disposal, *Agriculture, Metals, Heavy metals, Nitrogen, Phosphorus, Nutrients, Fertilizers, Pathogens, Fate of pollutants, Aesthetics, *United Kingdom, Public health, Sludge utilization.

In the United Kingdom about 45% of sewage sludge is applied to agricultural land. For this use several factors are important: chemical quality (especially metals), microbiological quality, esthetic quality, marketability, and reliability of treatment and disposal processes. A table lists the acceptable limits of application for each toxic element. Cadmium is of greatest concern because it is toxic to humans. Zn, Cu, and Ni are phytotoxic in high concentrations. Pathogens of primary concern (salmonellae, intestinal parasites, particularly human-beef tape worm, and potato cyst nematode) have caused problems in only a few cases (not in humans) as a result of poor operational practices. Complaints from the public regarding odors may be minimized by considering wind direction during application, avoiding residential areas, plowing immediately after application, and careful choice of tanker routes. A table lists 11 types of sludge from liquid raw to mesophilic anaerobic digested and the acceptable uses for each. Nutrient contents (N, P, K, Ca, and Mg) of 5 types of sludges are listed on a % dry sludge solids basis. (Cassar-FRC)
W84-00558

SEWAGE SLUDGE HYGIENISATION BY GAMMA RAYS: AN OVERVIEW,
H. Herrnhut.
Water Services, Vol 86, No 1041, p 539, 1982. 1 Fig, 3 Ref.

Descriptors: *Sludge disposal, *Wastewater treatment, *Irradiation, Sludge thickening, Dewatering, Bacteria, Fecal coliforms, Salmonella, Public health, Land disposal.

Anaerobically stabilized sludge is irradiated at a Sulzer gamma irradiation plant in Munich. It is first filled into an above ground metering silo, from where it is passed into the irradiation shaft and then circulated for a fixed time by pumps taking it past the radiation source many times. A dose of 3000 Gray is sufficient to kill disease germs. Together with the activity level of the sources, the dose determines the duration of irradiation, after which the sludge is discharged by pumping. The cobalt-60 sources employed are accommodated in the double wall of a central tube in the irradiation shaft. They are cooled continuously with water in a separate circuit and monitored for leakage. After irradiation the total count of bacilli and Enterococci is reduced by 2 log on the average, and Enterobacteriaceae by 5 log. The counts of fecal bacilli and Salmonellae reduced by gamma irradiation do not increase again on thickening in the dry beds. The effects of irradiated sewage sludge on soils and plants are extremely favorable. Nutrients and trace elements present can be used directly by plants and also influence a number of soil factors. When conventional processes are replaced by irradiation, as a rule the input of primary energy is reduced too. The irradiation plant requires only electrical energy, whereas conventional processes usually consume heat also. (Baker-FRC)
W84-00560

IN-SITU AND ON-SITE BIODEGRADATION OF INDUSTRIAL LANDFILL LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
R. C. Ahlert, and D. S. Kosson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136787, Price codes: A03 in paper copy, A01 in microfiche. U.S. Dept. of the Interior, OWP. Center for Coastal and Environmental Studies Completion Report, June 1983. 21 p, 9 Fig, 4 Tab, 10 Ref. OWRT A-062-NJ(1), 14-34-0001-1132.

Descriptors: Industrial wastewater, *Leachates, *Biodegradation, Wastewater renovation, *Landfills, Soil bacteria.

Leachate from industrial landfills threatens surface water and groundwater quality and can pose significant management problems. In-situ and on-site treatment processes avoid the economic and technical disadvantages, as well as environmental risks, incurred by transport of this type of hazardous material to alternate treatment facilities. An in-situ/on-site treatment process has been developed utilizing biodegradation by a mixed microbial population, subsequent to lime flocculation pretreatment. Biodegradation is viewed as occurring in the landfill itself or in an adjacent soil system. To investigate the proposed treatment process, scale field experiments have been designed carried out. A pilot-scale field installation, co ing of six soil columns, two feet in diameter five feet deep, have been exposed to leachate cation under natural environmental conditions periments were conducted using specimen sandy loam and clay loam soils. The experi were designed for complete effluent recover lowing material balances. Vacuum was appli the base of each column, balancing capillary f and simulating natural drainage and water r tion. Variables included hydraulic, organic ca and nutrient loading rates, soil type and env mental conditions. The field experiment was ated for 169 days in 1982. Influent flow averaged about 10 liters/sq. meter/day. L volumes were recovered fully, except for expe minimal losses due to evaporation. Overall or carbon removal exceeded 90%. Reduction excess of 95% were readily attainable.
W84-00686

5F. Water Treatment and Quality Alteration

DESORPTION OF COMPOUNDS DURING ERATION OF GAC ADSORPTION SYSTE
Illinois Univ. at Urbana-Champaign. Dept. of Engineering.
W. E. Thacker, V. L. Snoeyink, and J. C. Crittenden.
Journal of the American Water Works Ass ation, Vol 75, No 3, p 144-149, March, 1983. 8 7 Tab, 22 Ref.

Descriptors: *Activated carbon, *Organic c pounds, *Desorption, Adsorption, Model stu Mass transfer, Hydraulic loading, Chlorinated drocarbons, Equilibrium, Water treatment.

Desorption of organic compounds from gran activated carbon was studied with a verified m ematical model to evaluate factors caused by duction in influent concentration or by complet Compounds chosen for study were chloroform bromodichloromethane. For desorption resul from a decline in influent concentration the ove rate of adsorption decreases with increasing car particle size and decreasing surface diffusivity, transfer coefficient, equilibrium capacity, isoth slope, and bed length. Higher hydraulic loadi produce a slower rate expressed as mass deso per bed volumes passed and a faster rate expres as mass desorbed per time. For desorption res ing from competition, the extent of overshoot creases with decreasing surface diffusivity, transfer coefficient, and bed length, and increas hydraulic loadings and particle size. Basically, proved mass transfer leads to faster or grea desorption. A decline in influent concentration competition can produce effluent concentrati greater than influent concentrations for a sign cant period of time, possibly several weeks. system designated for good adsorption is likely to desorb efficiently. (Cassar-FRC)
W84-00385

MODELING COPPER CORROSION WATER WITH LOW CONDUCTIVITY USING ELECTROCHEMICAL TECHNIQUE
Washington Univ., Seattle. Dept. of Civil Engineering.
R. D. Hilburn.
Journal of the American Water Works Asso ation, Vol 75, No 3, p 149-154, March, 1983. Fig, 2 Tab, 10 Ref.

Descriptors: *Copper, *Corrosion control, *Kine ics, Water treatment, Water distribution, Pipe Flow velocity, Temperature effects, Seattle, Was ington, Tolt River, Aggressive water.

Corrosion rates of copper in synthetic water (co taining inorganic anions and cations found in Sea tle's Tolt River supply) were measured using ele trochemical methods and coupon tests. Models f control of corrosion rate were chemical reactio diffusion of reactive species through the oxide film and diffusion of reactive species through the sol

Experimental temperatures were 5, 15, and 25 es C; pH ranged from 6.0 to 8.3. In this water y solution diffusion was most rate limiting, ved by oxide film transport and kinetics. In al, corrosion rate decreased with an increase and a decrease in temperature. Increases in flow velocity through a copper tube would se the corrosion rate to a point at which sion becomes controlled by the mechanism, ion through oxide film. The most effective r corrosion control technique for this water ucing the kineticrate, with added protection reased pH. (Cassar-FRC)
00388

TY AND THE HUMAN FACTOR,
nd Dept. of Wastewater Treatment, TX.
ith.
r/Engineering and Management, Vol 129, No 32-34, 1982.

riptors: *Safety, *Water treatment industry, upations, Occupational hazards, Hazards, Acts.

water pollution control field is faced not only enormous technical problems, but also with f the worst accident rates of any industry. A program consists of four main elements: training, safety inspections, accident investis and protective safety equipment. Accidents are specific to the water treatment field le falls and drowning hazards. Significant ds are also posed by trickling filters in three the force with which the water causes the arm to rotate; the fact that most filter arms uilt too close to the bed of media and could an operator if he slipped and fell in the path e rotating filter arm; and the extremely slip- nature of the filter media biomass, which ly increases the likelihood of an inadvertent Hazards due to confined space entry include areas as manholes, lift stations, wet wells and obic digesters. Collection and distribution n safety includes dealing with confined space s, traffic and trenches. Chlorine, a deadly gas, netimes used carelessly due to overfamiliarity it. The same can be said for other hazardous icals used in the treatment plants. Harmful sure to other chemicals which enter the m as pollutants must also be considered. r-FRC)
00486

SH WATER FOR THE KEYS,
Florida Water Management District, West Beach. Dept. of Resource Management.
York.
r/Engineering and Management, Vol 129, No 30-31, 1982.

riptors: *Water conveyance, *Water demand, r distribution, Aqueducts, *Florida, Florida

Florida Keys project is undoubtedly one of largest and most demanding installations of le iron pipe tackled so far. The pipeline design d for 453,300 ft or about 87 miles of pipe, ly overland trenched, but with several suba- us crossings and 11 bridge crossings. Of this, st 70 miles consists of ductile iron, and the ining 17 miles is steel. The new pipeline was gned to be of more than one size. From Florida to Tavernier a 36 inch pipe was used. From rnier to Marathon, 30 in was installed. From thon toward Key West, 24 in pipe was used. e is also a 12 in spur from Key Largo to n Reef. The total length of the Florida Keys duct system is about 131 miles, thought to be ongest treated water line in the United States. cost of the line was $50 million. (Baker-FRC)
-00490

OMMENDED STANDARDS FOR WATER RKS.
primary bibliographic entry see Field 8A.
-00501

HYDRAULIC AND GEOLOGICAL PROBLEMS OVERCOME AT BOBCAYGEON'S WATER AND SEWAGE TREATMENT PLANTS,
P. J. McGrenere.
Water and Pollution Control, Vol 121, No 1, p 12-13, January/February, 1983.

Descriptors: Water treatment, Wastewater treatment, Bobcaygeon, *Ontario, Aeration.

A water treatment and wastewater treatment system was designed for Bobcaygeon, Ontario, a resort area with variable population, located on a thin layer of till overlying bedrock. Part of the village is located on three small islands made from fill dredged out of the Trent Canal. The existing diatomaceous earth water treatment plant is used during low demand periods in winter. Two package plants (contact zone, tube settler clarifier and dual media self backwashing filters) go on stream for summer visitors. The wastewater treatment plant consists of two separate extended aeration units. Both are used in summer, one in winter. The hydraulic grit removal channels and outfall are common to both plants. The fissured limestone under the facility was capped with concrete, and urethane insulation was installed to prevent frost heaving. Final costs for the project, serving 5600 persons in the summer, were $11.2 million. (Cassar-FRC)
W84-00515

CLINOPTILOLITE IN DRINKING WATER TREATMENT FOR NH4+ REMOVAL (UTILISATION DE LA CLINOPTILOLITE EN POTABILISATION DES EAUX--ELIMINATION DE L'ION NH4+),
Rennes-1 Univ. (France). Lab. of the Chemistry of Water and the Environment.
M. Gaspard, A. Neveu, and G. Martin.
Water Research, Vol 17, No 3, p 279-288, March, 1983. 12 Fig, 3 Tab, 5 Ref.

Descriptors: *Ion exchange, *Ammonium, *Water treatment, *Clinoptilolite, Hardness, Cations, Zeolite.

Ion exchange was used to remove ammonium ions in drinking water treatment process. Clinoptilolite, a natural cation zeolite, had a small ammonium ion exchange capacity compared with its total capacity of 2.17 meq per g. In a soft water (35-50 mg per liter Ca) the practical ion exchange capacity was 0.06 and 0.108 meq per g for ammonium concentrations of 1 and 2 mg per liter, respectively. The treated volume of water to breakthrough, defined at 0.5 mg per liter ammonium, was > 720 bed volumes. Capacities for hard water treatment were less. Upflow regeneration proved more effective than downflow regeneration in reducing ammonium leakage. Pilot tests showed an ammonium leakage of 0.2 mg per liter and a treated volume to breakthrough (0.5 mg per liter) of 750 bed volumes for a 2 mg per liter ammonium influent. After three regenerations in a second column performance decreased by 25%; ammonium leakage increased but remained less than 0.5 mg per liter. (Cassar-FRC)
W84-00520

PROVING THE POINT FOR DISSOLVED AIR FLOTATION IN POTABLE WATER PLANT.
Water Sciences, Vol 84, No 1009, p 150-151, March, 1980.

Descriptors: *Flotation, *Aeration, *Water treatment facilities, Potable water, Dissolved air flotation, Glendye Treatment Plant, Scotland, Bewl Bridge Water Treatment Works, *England, Flocculation, Filtration.

An article published in Water Services, Vol 84, No 1006, p 19, January, 1980, described the Bewl Bridge water treatment plant as the first of its kind to use dissolved air flotation. The present article describes earlier applications of DAF. Although the Bewl Bridge plant was the first to be designed and built from conception around this process, Water Management Limited was the first company to introduce DAF on a commercial scale. The first DAF plant of this company was installed in 1975 at the Glendye Filter Station near Aberdeen, Scotland. The high color of the raw (peaty) water at Glendye required that alum flocculation be supplemented with dissolved air flotation. About 8 potable water plants are currently in operation. Relocatable package DAF plants are now available. These are quickly installed and may be moved as needed. DAF is also used in wastewater treatment. High throughput is possible, and microprocessor control has been implemented. (Cassar-FRC)
W84-00561

EFFICIENCY OF POINT-OF-USE TREATMENT DEVICES,
Everpure, Inc., Westmont, IL.
P. Regunathan, W. H. Beauman, and E. G. Kreusch.
Journal of the American Water Works Association, Vol 75, No 1, p 42-50, January, 1983. 12 Fig, 10 Tab, 15 Ref.

Descriptors: *Water treatment, *Activated carbon, *Carbon filters, *Membrane filters, *Reverse osmosis, *Performance evaluation, Suspended solids, Coliforms, Organic compounds, Pesticides, Adsorbents, Potable water, Filters, Filter media.

The performance efficiency of two point-of-use water treatment devices was evaluated in a barrage of testes. One device consisted of a granular activated carbon bed and a precoat filter, while the other was made up of a reverse osmosis (RO) unit, a prefilter and two granular carbon adsorption units. The granular-precoat device was successful in removing 80-90% of the chloroform and carbon tetrachloride from spiked samples for at least 3700 liters of treated water, while the RO unit system removed 95-97% of trihalomethanes and chloroform from spiked samples for at least 4900 liters of treated water. Point-of-use treatment devices were also capable of removing large amounts of pesticides from spiked treated water samples, but in the removal of several inorganic contaminants, a steady state was reached within the first hour of operation for RO modules. RO and granular precoat devices were very efficient at removing asbestos fibers, protozoan cysts and volcanic ash from treated water samples. Evidence is presented to show that precoat carbon filters do not consistently yield significantly higher levels of bacteria compared with influent levels. In RO-carbon devices, higher levels of indigenous organisms can be reduced by flushing 3.7-7.5 liters of water through the system. Both the granular-precoat device and the RO-carbon system did not encourage the growth of Escherichia coli, even under quiescent conditions. It was concluded that, if properly used, point-of-use treatment devices could effectively supplement centralized water treatment systems. (Geiger-FRC)
W84-00569

DISCUSSION OF: ROLE OF ADSORPTION IN BIOLOGICAL EXTENDED ACTIVATED CARBON COLUMNS, AND AUTHOR'S RESPONSE,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W84-00570

DISINFECTION, WATER QUALITY CONTROL, AND SAFETY PRACTICES OF THE WATER UTILITY INDUSTRY IN 1978 IN THE UNITED STATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
R. C. Hoehn, and J. D. Johnson.
Journal of the American Water Works Association, Vol 75, No 1, p 51-56, January, 1983. 17 Tab, 3 Ref.

Descriptors: *Drinking water, *Water quality control, *Disinfection, *Chlorination, *Surveys, *Utilities, *Water treatment, Data collections, Chlorine, Organic compounds, Water quality, Turbidity.

Answers to questionnaires sent to more than 300 water utilities in March of 1978 were examined to gain information of disinfection, water quality control and safety practices before making treatment

modifications to control trihalomethane (THM) levels in drinking water. Results showed that high levels of gaseous chlorine were being used at more than one point by most utilities, but one-third of the respondents indicated that chlorine was only applied in the distribution system. Most respondents reported poor control of chlorine residuals. The majority of utilities surveyed made no attempt to differentiate between free and total chlorine residuals; the most commonly used method of detection was DPD technique. In 25% of the utilities responding, chlorine-contact times were usually less than 12 minutes. Less than half of the 332 utilities responding used the standard plate count for reporting bacteriological quality. Of those that did, very high bacteria levels were reported. In 20% of 123 systems, chlorine demand was over 5 milligrams/liter, and iron and manganese levels were high, while turbidity was generally quite low. Few utilities surveyed practiced dechlorination. (Geiger-FRC)
W84-00572

SURVIVAL OF SOME FAECAL INDICATOR BACTERIA IN DRINKING WATER,
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
S. F. Jazrawi, and A. K. Al-Hindawi.
Journal of Environmental Science and Health, Part A, Vol 17, No 6, p 789-796, 1982. 3 Tab, 7 Ref.

Descriptors: *Chlorination, *Bacteria, *Water treatment, Baghdad, *Iraq, Turbidity, Coliforms, Streptococcus, Fate of Pollutants.

The length of time required for complete kill of indicator bacteria, E. coli and Streptococcus fecalis, in Baghdad, Iraq, water at the highest chlorine dose (0.8 mg per liter of chloride of lime) was 2.0 and 0.5 hours, respectively. Since the residual chlorine in city water was 0.1-0.4 mg per liter, the currently used chlorine doses will have to be increased to provide clean and safe water. Raw water samples were high in turbidity (132 NTU). (Cassar-FRC)
W84-00583

INSTRUMENTATION, TELEMETRY AND AUTOMATION: STANDARDS FOR WATER INSTRUMENTATION,
Northumbrian Water Authority, Gosforth (England).
D. G. Hall.
Water Services, Vol 86, No 1042, p 583-584, 586, 1982. 1 Fig.

Descriptors: *Standards, *Measuring instruments, Planning, Water management, British Standards, Regulations, Water quality standards, Design standards, Specifications.

The availability of well proven standards is fundamental to good practice and essential for manufacturers and users alike in the field of measurement. A British Standard applied to instrumentation serves the needs of the user related to the physical phenomenon to be measured, comprises the statement of the needs of the user to the manufacturer to show him the expectation of the user, and should be used by the manufacturer to declare to the purchaser that his instrument has been constructed so that it will produce the data he requires at the level of quality he needs. The procedure to be followed in developing a standard is briefly described. Since the development and publishing of an international standard takes up to five years, those drafting the standards must have at least ten year horizon in view. (Baker-FRC)
W84-00587

5G. Water Quality Control

THE DYNAMICS OF GROWTH, THE EFFECTS OF CHANGING AREA AND NITRATE UPTAKE BY WATERCRESS NASTURTIUM OFFICINALE R. BR. IN A NEW ZEALAND STREAM,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
C. Howard-Williams, J. Davies, and S. Pickmere.
Journal of Applied Ecology, Vol 19, No 2, p 589-601, August, 1982. 6 Fig, 4 Tab, 29 Ref.

Descriptors: *Nitrogen removal, *Nitrates, *Watercress, *Water quality, Streams, Water quality control, Plant growth, Seasonal variations, Nutrients, Nutrient uptake.

The growth of watercress in a stream was related to the seasonal removal of dissolved nitrogen and its incorporation into plant biomass. The maximum relative production rate occurred in mid-summer, being 0.0569 g/g/day. Leaf tissue and root tissue both increased early in the growing season, but in late summer and winter plants had a high proportion of stem, up to 60%. The changing area of the plant population complicated calculations of plant production and the interpretation of production rate/mean monthly quadrat biomass ratios. The same factor also affected the calculation of nutrient uptake. In mid-summer the field measurements of nitrogen uptake by plant showed that 1.140 g N/sq m/day was accumulated. A pattern of nitrate-nitrogen loss from the stream water was demonstrated; this loss could all be accounted for by watercress uptake, which exceeded (to a greater or lesser extent depending on the effect of changing area) the loss from the stream. The nitrogen-rich soils of the cress beds could provide the deficit. Very fast growth rates and a high nitrogen affinity make watercress an ideal plant for stripping nitrate from stream water. However, nitrate uptake is a summer phenomenon only, and rapid decomposition rates of cress suggest that much of the stripped nitrogen will eventually be returned to the water. Denitrification in the Whangamata cress beds does occur, but this apparently accounts for a small portion of the nitrate lost from the stream during summer. (Baker-FRC)
W84-00354

ESTABLISHING STANDARDS TO CONTROL DIRECT AND INDIRECT DISCHARGERS.
Clearwaters, Vol 12, No 3, p 5-8, 1982. 1 Ref.

Descriptors: *Water pollution control, *Standards, Water quality, Water quality control, Water quality standards, Legislation.

In order to achieve the goals of the Clean Water Act, certain effluent limitations must be based on water quality standards. Only through regulating dischargers on the basis of the needs of the receiving water can a reasonable, cost effective approach to water pollution control be implemented. Some of the strengths and weaknesses of the existing standard-setting process under the present Clean Water Act are described. It is suggested that Congress should give priority to establishing a single system for controlling direct dischargers and a second system, if needed, for indirect dischargers. Three possible systems considered include the use of water quality standards, a technology-based categorical standard, and pollutant-specific guidance systems. Since it would take at least 10 years to fully implement a water quality-based system, the NYWPCA believes that, in the interim, the Act should mandate that S/NPDES permits be issued with effluent limitations that are based on PS criteria. Not only will such an interim approach enable maximum utilization of existing data while assuring an almost immediate improvement in the quality of treated wastewater discharged nationwide, but it will also provide a common ground for individual permit negotiation. (Baker-FRC)
W84-00357

LONG-TERM STUDY OF VIRUS CONTAMINATION OF SURFACE WATER IN THE GERMAN DEMOCRATIC REPUBLIC,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
For primary bibliographic entry see Field 5A.
W84-00365

TOXICOLOGICAL FUNDAMENTALS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
G. D. Boardman, and J. H. Sherrard.
Water/Engineering and Management, Vol 130, No 3, p 34-36, March, 1983. 8 Ref.

Descriptors: *Toxicity, Water pollution e
Hazards, Carcinogens, Absorption, Dosage

Basic facts about toxicology for water wastewater personnel include several defin Toxicity is the capacity of an agent to cause hazard is the probability that injury will Exposures are acute (hours), subchronic (up months), and chronic (3 months or more). effects occur at the site of contact, systemic e at a site other than the point of contact. Dos the most important factor governing the abil an agent to cause harm. Dosage appears a lethal dose to 50% of the test population (L maximum allowable concentration (MAC), th old limit value (TLV), or maximum contam level (MCL). Other factors in toxicologic e ments include species, sex, age, activity, hi and physiological condition of subject; anator behavioral and physiological differences; do route of administration (dermal, oral, respira etc.); temperature, pH, humidity, etc.; stati significance of data; interaction with other ag and storage, transformation, and excretion. partition coefficient of a compound has been ed to some toxicological properties. Cancer- ing agents are sometimes classified into geno (react covalently with DNA, such as vinyl ride) or epigenetic (solid-state carcinogens, su asbestos, hormones, and immunosuppres (Cassar-FRC)
W84-00481

SCHENECTADY COUNTY AQUIFER PRES VATION STRATEGY PROGRAM.
Schenectady County Planning Dept., NY.
Final Report, August 1980. 32 p, 14 Fig, 1 App

Descriptors: *Aquifer management, *Aquifer c acteristics, *Groundwater storage, *Water sources development, Flood plain managem Planning, Water management, Regional deve ment, Rivers, Water supply systems, Water sup Water consumption, *New York.

Five Schenectady County municipalities and n than 80% of its residents rely entirely on subsurface gravel deposits of the Mohawk Va for their public water supply. This aquifer area been increasingly prone to development due to construction of an interstate highway and the p sures of suburban expansion. A report compl in 1978 recommended measures to preserve critical aquifer areas. A subsequent report in described the existing and projected best uses each parcel and the costs to either purchase restrict the easements to each. The current aqu preservation strategy suggests preserving th areas that are the most important to existing future public water supplies. This report list wide range of actions that must be instituted protect the aquifer from contamination originat outside of the critical areas. The implementat plan recommendations include creation of a cou water council, upgrading the classification of Mohawk River, flood plain management, s source designation for the aquifer, collection letters of record for land parcels, and spill clea coordination. (Garrison-Omniplan)
W84-00498

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

CONFLICT AND RISK IN THE OPTIMU MIX OF ADJUSTMENTS TO FLOODS,
Purdue Univ., Lafayette, IN. Water Resources R search Center.
T. L. Morin.
Available from the National Technical Informati Service, Springfield, VA 22161 as PB84-1251 Price codes: A04 in paper copy, A01 in microfich Technical Report No 152, September 1983. 53 p Fig, 156 Ref. OWRT-B-126-IND(1), 14-34-000 1224.

Descriptors: *Flood control, *Optimization, Flo damage, Flood plain, *Nonstructural alternative

ision making, Preference order dynamic pro-
ming, Multi-objective planning, Vector opti-
ion.

r resources agencies are operating and plan-
in an environment which is complicated by
ple, oftentimes conflicting objectives, uncer-
es and risks. The situation is especially critical
od control because of the magnitude of the
damages, the number of conflicting objec-
and impacted groups, and the inherent mete-
gical uncertainties. Floods are the most wide-
d geophysical hazard in the United States and
account for greater average annual property
than any other single geophysical hazard.
realization among others has led to an increas-
wareness and interest in the role of nonstruc-
measures such as floodplain zoning, land use
ation, insurance, and warning as an important
integral part of any overall flood damage
ation program. However, determining 'opti-
nixes of adjustments to floods is very difficult
se of the number of conflicting water re-
es objectives, the degree of interdependence
een the structural and nonstructural measures,
ultitude of feasible combinations of structural
onstructural measures which must be consid-
over time and space. This report discusses
ple objective optimization and decision
g in the context of flood control and devel-
dynamic approach which involves the amal-
tion of the often disparate fields of utility
y and vector optimization into an integrated
odology based on the notions of 'preference
dynamic programming,' a recursive algo-
not requiring the existence of a real-valued
n function. This report also discusses practical
involved with the use of the method as well
her implementation and computational details.
-00447

CUSSION: 'OPTIMAL RESERVOIR MAN-
MENT AND CROP PLANNING UNDER
ERMINISTIC AND STOCHASTIC IN-
WS,' BY C. C. MAJI AND E. O. HEADY,
ornia Univ., Davis. Dept. of Civil Engineer-

primary bibliographic entry see Field 4A.
-00526

ANAGEMENT MODEL FOR DETERMIN-
ACCEPTABLE TYPES AND LEVELS OF
REATION AT PUBLIC DRINKING
ER RESERVOIRS,
achusetts Univ., Amherst. Water Resources
arch Center.
. Klar, Jr., M. Gross, P. J. Murphy, E. M.
oney, and M. S. Switzenbaum.
lable from the National Technical Information
ice, Springfield, VA 22161 as PB84-132448,
e codes: A12 in paper copy, A01 in microfiche.
er Resources Research Center Publication No
Massachusetts Univ., Amherst, June 1983. 243
Fig, 48 Tab, 152 Ref, 16 Append. OWRT B-
MASS(1), 14-34-0001-1233.

criptors: *Cost-benefit analysis, *Domestic
r, Model studies, Project planning, *Recrea-
Recreation demand, Recreation facilities,
rvoirs, *Reservoir operation, Use rates,
ter policy, Quabbin Reservoir, Beaches,
ping, Competing uses, Cost repayment, Cost
ng, Fishing, Fish management, Forest man-
ent, Hunting, Multiple-purpose reservoirs,
reation wastes, Reservoir fisheries, Social as-
s, Waste disposal, Water sports, Water supply,
dlife conservation, Wildlife management, Mas-
usetts.

anagement model was developed for determin-
optimal mixes of recreation activities at public
king water reservoirs. Quabbin Reservoir, lo-
d in central Massachusetts, served as a case
y for the model. An interdisciplinary research
was formed to study (1) the impact of select-
ecreation activities on water quality, (2) public
and and willingness to pay for selected recrea-
activities at Quabbin, (3) the carrying capacity
ential of the reservoir and (4) the cost-benefits
ciated with increases in recreation at Quabbin.
study variables were integrated into a quadrat-
ic programming model producing optimal recreation activity mixes as outputs. The optimal mix included hiking, fishing, picnicking (presently permitted activities), canoeing, sailing and swimming (presently prohibited activities). These activities were found to be cost-effective (assuming the use of reasonable entrance fees) and not deleterious to water quality. Nutrients, particularly from wastewater, should not be permitted to enter the water since current phosphorous levels may be at a critical point. This can be assured with proper precautions and effective management techniques. The model was sensitive to management objectives; recommendations were limited to activities that would not lower the existing high quality of Quabbin water.
W84-00592

6B. Evaluation Process

REAL TIME ADAPTIVE CLOSED LOOP CONTROL OF RESERVOIRS WITH THE HIGH ASWAN DAM AS A CASE STUDY,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
R. L. Bras, R. Buchanan, and K. C. Curry.
Water Resources Research, Vol 19, No 1, p 33-52, February, 1983. 16 Fig, 7 Tab, 13 Ref.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Flood control, Aswan Dam, Egypt, Model studies, Stochastic hydrology, Irrigation, Toshka Spillway, Multipurpose reservoirs.

An algorithm incorporating real time streamflow forecasts into reservoir operation was used to predict inflows into the High Aswan Dam. This adaptive control technique can handle situations where streamflow transition probabilities and system objectives are continuously updated and changing over finite transient periods before achieving steady state conditions. A comparison of results obtained with a steady state stochastic dynamic programming approach was made with the heuristic operational policy which is used at the dam. Improvements in system performance depended on the system configuration. With operation of the Toshka spillway, the new scheme showed little improvement relative to the steady state scheme. For no Toshka spillway and annual abstractions from the Sudan of 16.5 billion cu m, considerable improvements were demonstrated using the new scheme. The most significant benefit is likely to be improved flood control. Streamflow forecasts for the beginning of a drought period are particularly important because they may allow the release of more water than needed to meet the irrigation requirements, thereby preparing storage space for high inflows which may follow. (Cassar-FRC)
W84-00391

DISCUSSION 'MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,' BY W. B. LORD,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 6D.
W84-00414

EVALUATION OF ECONOMIC RETURNS FROM INVESTMENT IN DOMESTIC RURAL WATER DEVELOPMENT,
South Dakota State Univ., Brookings. Dept. of Economics.
R. Hoffman, A. Lundeen, and R. Green.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120831. Price codes: A05 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, July 1983. 59 p, 20 Tab, 13 Ref, 1 Append. OWRT A-080-SDAK(1), 14-34-0001-2144.

Descriptors: *Domestic water, *Stock water, Water resources development, *Economic impacts, *Rural water systems, Livestock productivity, Agricultural productivity, Domestic rural water development, *South Dakota.

The impacts of a rural water system on livestock productivity and production in two counties in South Dakota were investigated. Both members and nonmembers of rural water systems were surveyed to learn if there were differences between the two groups in number of livestock on hand, stability in numbers of livestock, effects of drought on livestock numbers, and changes in productivity because of an assured supply of quality water. Reported incidences of livestock producers being forced to sell or board out livestock during drought were few and about equal for nonmembers and members. Rural water system members held a higher absolute number of cattle in Tripp County and all livestock in Moody County. However, the differences were significant only for milk cows and beef cows in Moody County for one year in the surveyed period. Tripp county nonmembers had a significantly higher number of breeding hogs on hand in all four surveyed years. No statistically significant differences were found between the groups in changes in number of livestock. About one-quarter of the rural water system members reported substantial increases in average daily gain due to the availability of good quality water. Approximately 10% reported decreased newborn mortality rates or decreased medicinal costs.
W84-00433

THE RED RIVER GORGE: THE EXISTENCE OF 'RECREATIONAL NICHES' AND THEIR MANAGEMENT IMPLICATIONS,
Kentucky Water Resources Research Inst., Lexington.
S. E. Alexander, B. R. Dewalt, and E. Scott.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120914, Price codes: A11 in paper copy, A01 in microfiche. Research Report No 145, September 1983. 232 p, 4 Fig, 49 Tab, 54 Ref, 2 Append. OWRT A-079-KY(2), 14-34-0001-9019(FY 79), 14-34-0001-0119(FY 80), 14-34-0001-1119(FY 81).

Descriptors: *Recreation facilities, *Recreation demand, *Recreation, Wild rivers, Tourism, *Red River, Kentucky, River recreation management, Social carrying capacity, Recreational niches, Visitor preferences.

This report examines the recreationists' socio-demographic characteristics, the recreational activities engaged in, their density tolerance levels, and their preferences for development of the Red River Gorge, Kentucky. Eleven 'recreational niches' (defined as a specific location within a recreation area occupied by visitors pursuing different kinds of leisure-time activities) were identified. Preservation of the niches are recommended as a means for maintaining both the ecological and social diversity of the Red River Gorge. Substantial increases in visitation has resulted in not only severe environmental degradation to the area but extensive overcrowding as well. These trends are presently overtaxing the management capabilities of the area. The pressing issue is how to effectively manage this area to preserve both its ecological and social attractiveness.
W84-00441

THE DREDGING DILEMMA: SYSTEM PROBLEMS AND MANAGEMENT SOLUTIONS.
New England River Basins Commission, Boston, MA.
Report, September 1981. 26 p, 14 Fig.

Descriptors: *Dredging, *Planning, *Harbors, *Coastal engineering, *Multiobjective planning, *Management planning, *Long-term planning, Waterfront facilities, Interagency cooperation, Evaluation, Economic aspects, Comprehensive planning, Disposal sheds.

While efficient harbor facilities contribute to the economic base of coastal regions, management of dredging has become a controversial public issue. In the private and public sectors there is currently no process for arraying and assessing future demands for dredging. This study examines dredging as a set of interrelated functions directed to a specific end. Three basic flaws, endemic to the

dredging system as a whole, are identified: (1) unclear objectives; (2) isolated reviews of dredging proposals; and (3) limited evaluations. A proposed solution is a management planning process that emphasizes interagency cooperation and the establishment of agreed-upon objectives to guide dredging decisions, and to provide a basis for evaluating the results of dredging initiatives. In addition to defining objectives and setting priorities, dredging management could be improved by identifying disposal sheds, developing sediment characterization criteria, designating public disposal sites, establishing disposal site management methods, and evaluating and updating the management program on a regular basis. Specifically regarding the dredging of New England and Long Island Sound waters, there are eleven feasible disposal sheds to which dredging management could be applied. (Garrison-Omniplan)
W84-00502

PROJECTED DEMANDS AND SUPPLIES OF WATER UNDER ALTERNATIVE ENERGY AND AGRICULTURAL DEVELOPMENT SCENARIOS IN THE GREEN RIVER DRAINAGE OF WYOMING,
Wyoming Univ., Laramie. Coll. of Agriculture.
D. R. Franklin, J. J. Jacobs, and P. J. Farris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132471, Price codes: A04 in paper copy, A01 in microfiche. Water Research Center Completion Report, August 1983. 53 p, 1 Fig, 9 Tab, 48 Ref, 1 Append. OWRT A-039-WYO(1), 14-34-0001-2154.

Descriptors: Water conservation, Water allocation, Saline water, Water resources development, *Water demand, *Water supply, Irrigation water, Industrial water, *Economic impact, Agricultural development, Energy development, *Wyoming, *Green River Basin.

Five alternative salinity management policy and agricultural growth scenarios were analyzed for the Green River drainage in Wyoming. A linear program model was developed that evaluates the economic impacts of water development with salinity management policies. The results indicate that energy development can take place without imposing undue salinity damage cost downstream if no additional development occurs downstream from Wyoming. However, large scale agricultural development could increase salinity damage cost in the form of reduced energy production and/or monetary cost to the State.
W84-00634

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

FACILITIES NEEDS SURVEY OF COMMUNITY PUBLIC WATER SYSTEMS,
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
P. A. Chiefari.
Report, April 1983. 64 p, 4 Fig, 33 Tab, 3 Append.

Descriptors: *Project planning, *Distribution patterns, *Water quantity, *Water supply, Aqueducts, Urban planning, Operating costs, Projections, Operating policies, Water rates, Water distribution, *Capital costs.

Many water systems in New York State suffer from capital and physical deficiencies. To correct these problems, it is necessary to determine their extent and estimate the cost of correction. A survey using personal interviews and mailed questionaires was conducted by the New York Department of Health. In New York State, 1,420 community public water supplies provide 16.5 million people with 3.7 billion gallons of water a day. The total statewide funding need was found to be $6.8 billion, with $4.2 billion required by New York City. The highest priority in preferred spending was given to distribution system improvements, with treatment, storage, and source a nearly equal second. Additional areas examined in interviews with water system personnel included water rates, metering and operations and maintenance. In terms of capital cost to remedy these needs, problems arise because the component costs are large and such costs weigh heavily against smaller systems whose per user annual assessments are high. Additionally, certain projects are so expensive that even the very largest systems would have difficulty in building them without federal assistance. A proposed water project for New York City, for example, is estimated to cost $3.4 billion. (Garrison-Omniplan)
W84-00496

6D. Water Demand

SMALL HYDRO MAY HELP CZECHOSLOVAKIA'S NEEDS.
For primary bibliographic entry see Field 4A.
W84-00410

HYDROPOWER PROSPECTS FOR SPAIN,
For primary bibliographic entry see Field 4A.
W84-00411

DISCUSSION 'MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,' BY W. B. LORD,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
R. L. Anderson.
Water Resources Bulletin, Vol 19, No 1, p 131-133, 1983.

Descriptors: *Water supply development, *Water demand, Denver, Colorado, Pricing, Water use, Municipal water.

In the original paper (Water Resources Bulletin, Vol 18, No. 2, p 271-277, 1982) the idea was presented that limiting water supply does not inhibit urban growth. Various studies were cited to show that growth occurs in areas where water supplies are limited. In an examination of residential use of water, the original author states that substantial savings in water use by householders. The argument is stated that industrial and commercial growth can be accommodated within existing municipal supplies if residential demands can be reduced. The discussant maintains that the suggestion to homeowners that lawns can survive on 70% of the water they are capable of taking up is illusory; that to put watering or waste of water on lawn watering on a gallon-per-day basis is clearly inaccurate and misleading, as residents in Colorado's Front Range cities water their lawns only rarely at present anyway; and that raising prices for water could turn out to be a lawn tax, with far reaching effects on the older, fixed-income area residents rather than on new members of the community. The discussant suggests that the Denver Water Board pursue its historic course of expanding the water supply. While this course has been criticized by certain environmental groups, the disrupting effects of this course are no worse and perhaps less burdensome than depriving urban areas of adequate water. (Baker-FRC)
W84-00414

DISCUSSION 'CONFLICT BETWEEN ESTABLISHMENT OF INSTREAM FLOWS AND OTHER WATER USES ON WESTERN STREAMS,' BY RAMOND L. ANDERSON,
Southern Methodist Univ., Dallas, TX. Dept. of Civil and Mechanical Engineering.
M. A. Collins.
Water Resources Bulletin, Vol 19, No 1, p 137-138, 1983. 2 Ref.

Descriptors: *Water resources development, *Legal aspects, *Water rights, Doctrines, Water demand, Recreational use.

The author of this discussion enlarges upon the theme of the main paper (Water Resources Bulletin, Vol. 18, No. 1, p 61-65, 1982) dealing with the problem of the attack on established appropriate rights and the appropriate rights doctrine itself by advocates of instream water use. Recent studies in Texas are cited to demonstrate the enhancement of natural conditions through appropriate water
agemment practices. Particular mention is m
the Possum Kingdom Reservoir constructed
Brazos River for the stated purposes of pre
tion and enhancement of fish and wildlif
recreation in generally recognized scenic
reaches below the reservoir. This dam, built
1930s, has enhanced downstream condition
nificantly over the years. While concern for
ational interests, in itself, is certainly accep
inadequate consideration of the impact of
ational objectives on other water uses, partic
established, existing uses, is another issue. Th
great diversity of problems arising as dif
groups compete for the limited water resour
the more arid regions of the United States.
conflict between legally recognized appro
rights and the rights sought to be imposed b
will likely become more intense in the fu
(Baker-FRC)
W84-00415

**REPORT ON GROUND WATER DEPE
ENCE IN NEW YORK STATE.**
New York State Dept. of Health, Albany. Bu
of Public Water Supply Protection.
For primary bibliographic entry see Field 2F.
W84-00499

**DEVELOPING AND MONITORING MUN
PAL GROUNDWATER SUPPLIES IN FL
IDA,**
West Coast Regional Water Supply Autho
Clearwater, FL.
G. Heath.
Journal of the American Water Works Ass
ation, Vol 75, No 2, p 64-67, February, 1983. 7
1 Tab.

Descriptors: *Water supply, *Monitoring, *W
*Florida, Water demand, Water supply devel
ment, Precipitation, Model studies, Geohydrolo
Crossbar Ranch Project, Drawdown, Water le
Wetlands, Environmental effects, Seasonal v
ation, Planning, Groundwater management.

The West Coast (Florida) Regional Water Sup
Authority, formed in 1974, relies on extensive d
to provide water for the rapidly growing a
seasonally variable population of the St. Pete
burg-Tampa area. Precipitation (and the grou
water resource's response to it) varies widely, b
annually and seasonally. When new well fields
planned, the Authority must consider the availa
hydrogeological information, water demand,
fects on groundwater levels of the proposed wi
drawal rates, and effects on the ecosystems. T
planning procedure is illustrated in the develo
ment of the Crossbar Ranch well field. This i
volved hydrogeologic tests and computer mod
ing of the effects of different well locations
groundwater level. Monitoring programs conce
levels in the 1500 private wells and 105 wetlan
and lakes within 2 miles of the well field, histor
lake trends, sinkhole activity, runoff and strea
flow water budgets, and the aquatic and terrestri
habitats. Of the $16.3 million spent for the Cros
bar project, 12.5% was for investigations and ma
agement system instrumentation. (Cassar-FRC)
W84-00573

**HYDROLOGY OF THE FLORIDIAN AQUIFE
IN NORTHWEST VOLUSIA COUNTY, FLOR
IDA,**
Geological Survey, Tallahassee, FL. Water Re
sources Div.
For primary bibliographic entry see Field 2F.
W84-00601

**PROJECTED DEMANDS AND SUPPLIES OF
WATER UNDER ALTERNATIVE ENERGY
AND AGRICULTURAL DEVELOPMENT SCE-
NARIOS IN THE GREEN RIVER DRAINAGE
OF WYOMING,**
Wyoming Univ., Laramie. Coll. of Agriculture.
For primary bibliographic entry see Field 6B.
W84-00634

)HYDROLOGY AND EFFECTS OF WATER
: IN THE BLACK MESA AREA, NAVAJO
) HOPI INDIAN RESERVATIONS, ARIZO-
logical Survey, Tucson, AZ. Water Resources
primary bibliographic entry see Field 2F.
-00642

. Water Law and Institutions

ABLISHING STANDARDS TO CONTROL
ECT AND INDIRECT DISCHARGERS.
primary bibliographic entry see Field 5G.
-00357

TION 10 OF THE RIVERS AND HARBORS
AND WESTERN WATER ALLOCATIONS -
: THE WESTERN STATES UP A CREEK
'HOUT A PERMIT,
on Coll., Chestnut Hill, MA.
G. Proctor.
on College Environmental Affairs Law
iew, Vol 10, No 1, p 111-182, 1982. 478 Ref.

criptors: *Legal aspects, *Water rights, United
es, California, Arid zone, Arid climates, Feder-
risdiction, State jurisdiction.

ecognized need for reform and the increasing
ral need for water may induce the federal
ernment to take on a greater role in western
r law in the future. This article analyzes the
nt to which the Rivers and Harbors Act can
should be used by the federal government to
nd its role in western water allocations. The
ry and development of western water law and
traditional role of the federal government in
ern waters is reviewed. The growing conflict
control of western waters and the possible
vation for an increased federal role is dis-
ed. This discussion focuses on the potential
icability of section 10 of the Act to state water
ations. Section 10 bars any unauthorized ob-
ctions to the navigable capacity of any waters
e United States and makes it unlawful to alter
nodify any navigable water without the ap-
al of the US Army Corps of Engineers. The
torial and subject matter jurisdiction of the
and the permit process are detailed. A close
ination is offered of California vs Sierra Club,
ch discusses specific issues left unresolved by
Supreme Court in that it refused to allow the
ntiffs the right to bring suit under the Rivers
Harbors Act. The article concludes with an
nination of the extent to which the Rivers and
ors Act can and should be used in the context
estern water allocation. (Baker-FRC)
-00368

OUNDWATER LITIGATION,
k Coll., New Brunswick, NJ.
Goldfarb.
er Resources Bulletin, Vol 18, No 5, p 899-900,

criptors: *Legal aspects, *Groundwater man-
ment, Supreme Court, Arizona, Nebraska,
er demand, Water use, Exportation, Aquifers,
er law.

US Supreme Court recently took action on
cases involving the regulating of transporta-
of groundwater by the states involved. Spro-
v. Nebraska was the more important, dealing
the constitutionality of a groundwater 'antiex-
ation' statute. Some antiexportation statutes
ibit any exportation of water. Others allow it
e recipient state has legislated reciprocal
s. Nebraska enacted a statute of the latter
, and the state Supreme Court upheld it, based
he view that groundwater is not an article of
merce. The US Supreme Court reversed this
, stating that groundwater overdraft is a na-
l problem and Congress has the power to deal
it on that scale. The second case, Town of
o Valley v. City of Prescott, raises questions
t the ownership of groundwater. The City
s 164 acres of land in the Valley. In 1948 the City drilled wells on some of its Valley property and began transporting groundwater through a 17 mile pipeline to its municipal customers. The Town of Chino Valley was incorporated in 1972 and began drawing groundwater from the same aquifer. The Town claimed the City was taking private property (groundwater) without just compensation. The common law doctrine of riparian rights in Arizona has been replaced by the appropriation doctrine except as regards percolating groundwater. Here the doctrine of reasonable use still applies. The state Supreme Court, and later the US Supreme Court upheld the decision, claiming that the overlying owner does not possess absolute ownership of groundwater but merely a right to the 'usufruct' (use) of the water, subject to state regulation. (Baker-FRC)
W84-00369

REPLY TO DISCUSSION 'POLICY PROBLEMS ASSOCIATED WITH WATERBORNE ASBESTOS', BY MICHAEL EDSON AND W. A. THOMPSON,
Iowa Univ., Iowa City. Dept. of Urban and Regional Planning.
M. F. Sheehan.
Water Resources Bulletin, Vol 19, No 1, p 127-130, 1983. 3 Fig.

Descriptors: *Asbestos, *Legal aspects, *Water pollution sources, Industrial wastes, Industrial discharges.

In this reply the author of the original paper (Water Resources Bulletin, Vol. 17, No. 2, p 275-279, 1981) deals with major points brought out in the discussion paper (Water Resources Bulletin, Vol. 19, No. 1, p 123-126, 1983). The original paper dealt with a temporary stay in discharges from the Reserve Mining Company into the environment, both air and water, of asbestos fibers. The discussion argues that the assertion of the original author that the temporary stay of the Appeals Court was based on the fact that the fiber levels were not occupational levels, that the low levels present could not be measured and therefore did not constitute a health risk, and that it was not known what level of exposure was actually unsafe, is incorrect. The original author replies that the decision clearly stated that the levels of contamination were not equivalent to the contaminated air found in an asbestos factory and the fibers ingested from the Duluth drinking water were not equatable to an occupational exposure level. That the levels of exposure were so low as to be unmeasureable as a health risk is stated in the original court's decision and the argument that this decision could not have been based on these facts but instead had to meet the four criteria set out in the rules for civil and apellate procedure is seen by the original author as a confusion of facts with procedural rules. Facts and procedures are not mutually exclusive in the law. Decisions of this sort must both have a factual basis and meet the rules of procedural due process. (Baker-FRC)
W84-00419

DISCUSSION: 'POLICY PROBLEMS ASSOCIATED WITH WATERBORNE ASBESTOS' BY M. SHEEHAN,
Arizona Univ., Tucson. Dept. of Philosophy.
M. Edson, and W. A. Thompson.
Water Resources Bulletin, Vol 19, No 1, p 123-126, 1983. 6 Ref.

Descriptors: *Water pollution sources, *Legal aspects, Liability, Torts, Asbestos, Policy, Public policy, Rights.

The discussants review and assess a presentation in Water Resources Bulletin, Vol 17, No 2, p 275-279, 1981 on the litigation arising out of the discharge of asbestos-like fibers into Lake Superior by the Reserve Mining Company. The most important aspect of the suit brought against Reserve was that public health and welfare were endangered through this discharging of asbestos-like fibers. The author of the original paper charges that the district court issued an injunction against Reserve's continued discharge purportedly on the basis of Section 504 of the Federal Water Pollution Control Act which permits injunctive relief when the public is faced with an imminent health hazard. However, in truth, the injunction was issued on the basis of the five complaints brought against the company and no determination that a hazard was imminent was made. A stay of the injunction was issued by a federal appeals court, but this was only a temporary stay, pending Reserve's appeal of the case on merits. The confusion of factual and normative issues is a dangerous flaw in argumentation. The charge of the original paper that by not regulating potentially harardous substances the government is contributing to economic inefficiency in the neoclassical sense is addressed by the discussants in stating that determinations of tort liability are not generally based on economic efficiency, but rather on considerations of justice and fairness with respect to compensation for harms incurred. The relevant claim would have been that not regulating the discharge of potentially hazardous substances constitutes a violation of certain principles of equity. (Baker-FRC)
W84-00420

WATER RESOURCES MANAGEMENT IN A FEDERAL SYSTEM: A COMPARATIVE ANALYSIS,
North Carolina State Univ. at Raleigh. Dept. of Political Science and Public Administration.
T. D. Edgmon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120864, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 203, September 1983. 209 p, 43 Tab, 2 Fig, 87 Ref, 1 Append. OWRT B-135-NC(1), 14-34-0001-1254.

Descriptors: *Water management, *Decision making, *Institutional constraints, *Governmental interrelations, *Water policy, Institutions, Local governments, State jurisdiction, Water Resources development, Water supply, Political constraints, Political aspects, Policy making, Planning, Regional planning, Water districts.

The objectives of this study were to review existing information on the organization of state, regional, and local water supply systems, determine the existing pattern of state water management institutions, analyze the evolution of substate water supply organizations in the state of Florida, determine the existing pattern of water resources decision making and intergovernmental relations in North Carolina, and evaluate a set of institutional and organizational alternatives suitable for consideration by policy makers in North Carolina. The study identifies four major types of state water resources management organization: unified, federalist, home rule, and fragmented. A survey discovered that state regulation of consumptive water use is becoming universal, even in the absence of a federal policy and program to provide incentives and sanctions. Most states have implemented their water resource regulatory programs on a decentralized basis, relying on either established local water organization, creating field offices with local policy boards, or developing basin control areas. Data from two surveys was analyzed to portray the structure of municipal organization in water supply, local official perceptions of water supply issues, the structure and process of intergovernmental relations, and an evaluation of local official preferences for areawide strategies of water supply allocation. Local officials generally do not rank water supply problems as serious ones, and prefer that the state continue to play a facilitative role in water areawide approach, and consider county government as a viable institution for water allocation among competing urban interests.
W84-00436

IMPEDIMENTS TO EFFECTIVE INTERACTIONS BETWEEN MULTIPURPOSE WATER DISTRICTS AND OTHER GOVERNMENTAL INSTITUTIONS IN URBANIZING AREAS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6F.
W84-00448

GROUNDWATER USE MANAGEMENT IN THE NORTHEASTERN STATES--LEGAL AND INSTITUTIONAL ISSUES.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132463, Price codes: A15 in paper copy, A01 in microfiche. Proceedings, Conference June 2-4, 1981, Pawling, NY. Center for Environmental Research, Cornell Univ., Ithaca, NY 303 p. Raymond L. S., ed. OWRT C-00176-T(No 0518)(8).

Descriptors: Legal aspects, *Groundwater, Model studies, *Contamination, Conservation, Permits, Data collection, Aquifers, Public trust doctrine, Costs, Priorities, Conjunctive use, Land Use, Zoning, *Groundwater pollution, *Water rights, *Water allocation, Policy making, Water shortage, Water use, Public participation, Aquifer systems.

Public authority to act (legal issues), the technical knowledge base for groundwater management, groundwater allocation, the interface between groundwater quality and quantity management, local government responses to groundwater shortages, and groundwater quantity as a managment issue in the Northeast. The doctrines of reasonable use and prior appropriation and their significance for the Northeast. Traditional responses to groundwater contamination problems in the Northeast. Existing common and statutory groundwater law in the Northeast in terms of their relevance to current problems. The state of groundwater knowledge in relation to public policy needs. Groundwater withdrawals in the Northeast in the context of well-drilling regulations, allocation permits, local land use controls, conservation programs, and public vs. private ownership. Case histories of local government response to groundwater shortages in Stoughton, Massachusetts; Chester County, Pennsylvania; and Long Island, New York. Local home rule approaches are contrasted to state level approaches to groundwater management.
W84-00594

6F. Nonstructural Alternatives

CONFLICT AND RISK IN THE OPTIMUM MIX OF ADJUSTMENTS TO FLOODS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W84-00447

IMPEDIMENTS TO EFFECTIVE INTERACTIONS BETWEEN MULTIPURPOSE WATER DISTRICTS AND OTHER GOVERNMENTAL INSTITUTIONS IN URBANIZING AREAS,
Utah Water Research Lab., Logan.
J. M. Bagley, F. W. Haws, W. B. Anderson, D. H. Hoggan, and L. Kapaloski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125152, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, July 1983. 165 p, 6 Tab, 6 Ref, 1 Append. OWRT B-170-UTAH(1), 14-34-0001-9136.

Descriptors: Water supply, *Institutional constraints, Legal aspects, *Water districts, Political constraints, State jurisdiction, Feasibility studies, Financing, Urban planning, Community development, *Utility extension, Utilities, Potential water supply, *Urban areas, Water management.

Scattered rural towns are largely served by individual water systems. Urbanization fills the areas between older communities and requires system expansions that encourage the smaller systems to combine and search for larger, higher quality, and often more distant and costly supplies. The western states have established a variety of special water districts to serve growing metropolitan areas. Over the years, these districts have had a variety of experiences, both successes and failures, useful in guiding organizational arrangements for supplying water during periods of urban expansion. The large public water districts in Utah, Arizona, Colorado, Nebraska, Oregon, and South Dakota provided the experience data for this study. Applicable statutes were reviewed, and structured interviews were conducted with district officials. The special districts serving a number of communities have often responded to visions of pending water shortage by committing themselves, legally and financially, to major water projects. These obligations constrain the district's flexibility to adjust its water supply system to changes in demand and supply situations. The political commitment required for their formation also restricts thoughtful examination of system management alternatives because of fears that new options will erode public support to continuing repayment. State government needs to exercise its oversight responsibility in promoting harmonious coordination between districts and the communities they serve and in reviewing their fiscal management policies.
W84-00448

6G. Ecologic Impact Of Water Development

LAND USE, NUTRIENT YIELD, AND EUTROPHICATION IN THE CHOWAN RIVER BASIN,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
N. J. Craig, and E. J. Kuenzler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120872, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 205, North Carolina State Univ., Raleigh, August 1983. 75 p, 16 Tab, 23 Fig, 125 Ref. OWRT B-127-NC(13), 14-34-0001-0274.

Descriptors: *Nonpoint pollution sources, *Water quality, *Eutrophication, *Land use, *Agricultural runoff, *Nutrients, Rivers, Model studies, Watershed management, Nitrogen, Phosphorus, Forests, Cultivated lands, Cropland, Fertilizers, Drainage, Livestock, Animal wastes, Erosion control, Wetlands, Swamps, Cycling nutrients, Nutrient removal, Channeling.

Land use changes within the Chowan River watershed over the past three decades were determined to assess their potential impact on recent water quality degradation and eutrophication of the Chowan River. The amount of harvested cropland has remained constant, but yields from major crops have increased, due partly to increased fertilizer usage. There has been a large increase in artificial drainage on farms from 1940 to 1978, approaching 12% a year. Approximately 67% of the farmland in the North Carolina Chowan watershed is now drained versus 6% in Virginia. A 30% decrease in oak-gum-cypress forested wetland occurred in the N.C. Chowan basin from 1964 to 1974. Swamp forests remove an estimated 83% of the total N and 51% of the total P in streams passing through them. Mass balance models suggested that, of the annual nitrogen inputs to the Chowan River (6.94 x 10 kg N/yr), agriculture contributes 62%, forests and wetlands 21%, and point sources 17%. Of the annual potential phosphorus inputs (3.06 x 10 kg P/yr), agriculture contributes 72%, forests and wetlands 22%, and point sources 6%. Recommendations for reducing nutrient overloading to the Chowan River include use of agricultural Best Management Practices to avoid overloading of soil with fertilizer of animal wastes, and protection of swamp forests so that these wetlands can remove nutrients before they enter the river.
W84-00437

ANALYSES OF NATIVE WATER, BOTTOM MATERIAL, ELUTRIATE SAMPLES AND DREDGED MATERIAL FROM SELECTED SOUTHERN LOUISIANA WATERWAYS AND SELECTED AREAS IN THE GULF OF MEXICO, 1979-81,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00605

BACKGROUND HYDROLOGIC INF TION IN POTENTIAL LIGNITE AREAS IN MISSISSIPPI, JULY 1982,
Geological Survey, Jackson, MS. Water R Div.
For primary bibliographic entry see Field
W84-00654

7. RESOURCES DATA

7A. Network Design

IRRIGATION-WATER QUALITY IN TH PHUR CREEK BASIN, YAKIMA AND B COUNTIES, WASHINGTON, APRIL THROUGH MARCH 1977,
Geological Survey, Tacoma, WA. Wat sources Div.
P. R. Boucher, and M. O. Fretwell.
Available from the OFSS, USGS Box 2542 Ctr. Denver CO 80225, Price: $11.50 in copy, $4.00 in microfiche. USGS Op Report 81-1008, 1982. 68 p, 16 Fig, 1 Plate, 20 Ref, 4 Append.

Descriptors: *Data collection, *Networks, toring, *Sampling, Irrigation water, Water Sediment yield, Nutrients, Water tempe Streamflow, Storm runoff, *Washington, S Creek basin.

A water-quality-sampling network was de for the Sulphur Creek basin to observe the of farming practices on irrigation. Sedime nutrient yield, discharge, and water tempe data were collected during the 1976 irri season and the following fall and winter suspended-sediment yield of the basin durin period was 2.0 tons per acre of irrigated cro Only about 3% of the net outflow of sed occurred during the nonirrigation season. yield computed by subbasin ranged from 0. tons per acre, depending mainly on land slop a high percentage of orchard land in the sub was probably also significant in reducing Nutrient outflows during the study period 1,180,000 pounds of nitrogen and 120,000 p of phosphorous. Nitrate-plus-nitrite represent of the nitrogen outflow in the irrigation seaso 84% in the nonirrigation season. The monit network was discontinued at the end of the period, due largely to insufficient farmer parti tion. Network sensitivity in the control subb was inadequate to detect the effects of a pla demonstration program of best management tices. (USGS)
W84-00541

SELECTED CLIMATIC CHARACTERIST OF THE SOUTHEASTERN UINTA BA UTAH AND COLORADO,
Geological Survey, Salt Lake City, UT. W Resources Div.
For primary bibliographic entry see Field 2B.
W84-00548

INDEX OF SURFACE-WATER STATIONS TEXAS, JANUARY 1982,
Geological Survey, Austin, TX. Water Resou Div.
E. R. Carrillo, and H. D. Buckner.
USGS Open-File Report 82-269, 1982. 25 p, 2 T 2 Maps.

Descriptors: *Index of surface-water stations, D collections, Indexes, Hydrologic data, *Texas.

This index shows the station number and na type of data collected, and the office principa responsible for the data collection. In addition the station number and name of the tide-le stations, a permanent numerical designation gaging stations has been adopted on a nationw basis; stations are numbered and listed in dow stream order. In the downstream direction alo the main stem, all stations on a tributary enteri above a main-stem station are listed before t station. A tributary entering between two ma stem stations is listed between them. A simil

er is followed in listing stations on first rank, other ranks of tributaries. To indicate the rank ny tributary on which a gaging station is situ- and the stream to which it is an immediate itary, each indention in the listing of gaging ons represent one rank. This downstream er and system of indention show which gaging ons are on tributaries between any two stations a main stem and the rank of the tributary on ch each gaging station is situated. (USGS)
-00643

TRUCTIONS FOR THE SUBMISSION OF TA TO THE MASTER WATER DATA DEX,
logical Survey, Reston, VA. Water Resources
. Williams.
GS Open-File Report 83-49, 1983. 25 p.

criptors: *Data storage and retrieval, *Data essing, *Indexing, *Information systems, In- nation exchange, Computers, *Master Water a Index(MWDI), *National Water Data hange(NAWDEX).

ructions are given for the computerized proc- g of data prepared for entry into the Master er Data Index of the U.S. Geological Survey's onal Water Data Exchange (NAWDEX), as ussed in the manual entitled 'Instructions for Preparation of Data for the Master Water Data ex.' Two processing procedures are provided: edit of data and the submission of data for age in the Master Water Data Index. These ructions are applicable to both new data being mitted for storage and to update transactions data previously processed and stored. (USGS)
-00680

. Data Acquisition

OWTH RESPONSE AND SPECTRAL CHAR- TERISTICS OF A SHORT SPARTINA AL- RNIFLORA SALT MARSH IRRIGATED TH FRESHWATER AND SEWAGE EFFLU- ,
aware Univ., Newark. Coll. of Marine Studies.
A. Hardisky, R. M. Smart, and V. Klemas.
ote Sensing of Environment, Vol 13, No 1, p 7, 1983. 1 Fig, 3 Tab, 36 Ref.

criptors: *Remote sensing, *Marshes, stewater disposal, Spartina, Salt marshes, Bio- , Vegetation, Lewes, Delaware, Radiance, ctral analysis, Salinity, Effluents, Water pollu- effects.

effects of irrigation with sewage effluent or a water were studied in a Spartina alterniflora sh near Lewes, Delaware. Vegetation response measured by harvesting biomass and by a l-held radiometer, which was configured to ch bands 3, 4, and 5 of the Landsat-4 Thematic per. Spectral radiance was 0.70 on Julian date 1980, for control and irrigated plots. In the rol plot it decreased gradually to 0.68 on date then decreased sharply to <0.60 by date 331. fresh water and sewage irrigated plots in- sed in radiance to about 0.73 on day 264 and ually decreased to 0.62 and 0.66, respectively, lay 331. The radiance data was significantly elated with live leaf biomass, live-dead leaf ass ratio and percent live leaf biomass. Radi- data suggested that live leaf biomass produc- stopped in August in the control plots and inued until October in the treated plots. Ap- ntly the nitrogen additions reduced the rate of py senescence. These results indicate that ote sensing could be a viable means of detect- stress and perturbations in Spartina salt shes. (Cassar-FRC)
-00431

DDING SOME LIGHT ON TURBIDITY,
. Crossley.
er Services, Vol 86, No 1042, p 591-592, 594, . 7 Fig, 3 Tab.

Descriptors: *Turbidity, *Measuring instruments, Turbidimeter, Water quality, Wastewater treatment.

A brief history of the development of methods for measuring turbidity is given. Basic configurations for different types of turbidity measuring devices are described. In basic or probe type instruments, arrangements are made to remove the probe from the liquid and clean the glass manually. The probe is then immersed in a sample of liquid which contains a minimum of suspended solids, and the output from the detector is adjusted to give a zero reading. The probe is then replaced in the liquid and will indicate the obscuration, either in percentage obscuration or NTUs depending on the calibration of the instrument. Some designers of commercially available turbidimeters consider that fouling of the cell windows can cause inaccuracies, and rather than compensate for loss of light transmission, they prefer to provide a method of cleaning the windows. Virtually all modern turbidity meters operate on the principle of optical obscuration; and many designs have been introduced to compensate for aging of lamps and photodetectors and errors due to fouling of the cell windows. However, a few turbidimeters are available in which a different approach has been used. Models are available which are based on the nephelometric principle, with the detector unit totally submersed in the liquid. Still another design is based on the appearance of a final settlement tank as a deep black hole with no apparent bottom. If the tank appears to contain water or other fluid, then some suspended solids are present. (Baker-FRC)
W84-00588

7C. Evaluation, Processing and Publication

SIMULATED STREAMFLOW DATA FOR NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W84-00492

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE BLOCKER AREA, PITTSBURG COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00540

SURFACE-WATER QUALITY DATA FROM SELECTED SITES IN WASHINGTON AFFECTED BY MOUNT ST. HELENS ERUPTIONS: MARCH 27 - SEPTEMBER 30, 1980,
Geological Survey, Tacoma, WA. Water Resources Div.
G. L. Turney, and J. M. Klein.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $20.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 81-1007, 1982. 154 p, 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Data collection, *Surface water, *Water quality, *Volcanoes, Mudflows, *Washington, *Mount St. Helens.

The volcanic eruptions of Mount St. Helens have resulted in the collection of many forms of hydrologic data. Chemical data collected from March 27 to September 30, 1980, to document the effects of the various volcanic events (mudflows, pyroclastic flows, deposition of ash) on the quality of surface water at selected sites in the State of Washington are presented in the report. (USGS)
W84-00542

HYDROLOGY OF AREA 15, EASTERN COAL PROVINCE, KENTUCKY AND TENNESSEE,
Geological Survey, Louisville, KY. Water Resources Div.
D. W. Leist, F. Quinones, D. S. Mull, and M. Young.
USGS Open-File Report 81-809 (WRI), January 1982. 81 p, 46 Ref.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, Surface water, *Coal mines, Geohydrology, *Acid mine drainage, Soils, Floods, Low flows, Water use, Land use, *Kentucky, Eastern Coal Province, Cumberland River, Rockcastle River, Laurel River, Tennessee.

Area 15, in Eastern Kentucky and Tennessee consists of 3,095 square miles in the Cumberland, Rockcastle and Laurel River basins. The area is underlain by Permian, Pennsylvanian, Mississippian rocks. The Breathitt Formation of Pennsylvanian age crops out in about 75% of the area and contains most of the coal. About 22 million tons of coal were produced in the area in 1978, 52% from surface mines. The terrain is steep with acidic soils. Forestry and pastures are the principal land uses. Precipitation ranges from 47 to 54 inches per year, and the 24-hour 10-year frequency storm averages 4.5 inches. Flood prone areas along the rivers have been defined or can be determined from relations with drainage area and physiography. Low flows are poorly sustained, with most streams draining less than 100 square miles approaching a 7-day 10-year minimum flow of zero. Ground water is generally of good quality, although high iron concentrations are common. Sandstones are the principal aquifers. Water levels fluctuate seasonally, and yields of wells are usually less than 50 gallons per minute but range from about 1 to 250. Mine drainage affects the quality of streamflow at most sites in mined basins. Sulfate concentrations are as high as 1,000 milligrams per liter. Other constituents such as iron and manganese also occur in higher concentrations in waters of mined basins. Acid mine drainage generally is neutralized near its source. Most of the water in streams has pH values in the 7-8 range. (USGS)
W84-00543

WATER RESOURCES OF THE GIG HARBOR PENINSULA AND ADJACENT AREAS, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
B. W. Drost.
USGS Open-File Report 81-1021 (WRI), 1982. 148 p, 14 Fig, 1 Plate, 17 Tab, 21 Ref.

Descriptors: *Hydrologic data, *Surface water, Groundwater, *Hydrologic budget, Groundwater recharge, Aquifer characteristics, Saline water, Encroachment, *Washington, Gig Harbor.

The study area is a remnant of a glacial-drift plain nearly surrounded by marine embayments. A water-resources appraisal was made because the area is experiencing rapid population growth. Additional ground water is available for use in the study area. At least 11 cubic feet per second, five times the 1978 rate of use, can probably be obtained. Ground-water quality is generally very good, with minor problems of excess iron, manganese, dissolved solids, chloride, and coliform bacteria. Total flow through the hydrologic system is at an average rate of 254 cubic feet per second, which includes 93 cubic feet per second of ground-water recharge. (USGS)
W84-00544

HYDROLOGIC DATA FOR THE POTOMAC FORMATION IN NEW CASTLE COUNTY, DELAWARE,
Geological Survey, Dover, DE. Water Resources Div.
M. M. Martin, and J. M. Denver.
USGS Open-File Report 81-916 (WRI), 1982. 148 p, 80 Fig, 7 Tab, 40 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Surface water, *Water quality, Wells, Pumpage, Water level, Aquifers, Transmissivity, Storage coefficient, Geohydrology, Chemical analysis, Hydrographs, *Delaware, New Castle County, Potomac Formation.

Hydrologic data for the Potomac Formation in New Castle County, Delaware, consists of records of historical ground-water pumpage, water levels, water quality, and surface-water discharge. Included are well records for 405 wells, and hydrographs

of water levels in 86 wells. Pumpage for 20 well fields are reported. Also included are stream-discharge hydrographs for 6 stations for water years 1979 and 1980, and historical low-flow measurements for 22 stations. In the analysis of 23 aquifer tests, transmissivity and storage coefficient values for the Potomac Formation range from 454 to 8480 square feet per day and 0.0026 to 0.000056, respectively. Vertical hydraulic conductivities of confining beds in the Formation range from 0.0083 to 3.2 feet per day. (USGS)
W84-00545

GEOHYDROLOGY OF PRINCIPAL AQUIFERS IN THE REPUBLICAN RIVER BASIN, KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
L. E. Dunlap.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $15.50 in paper copy, $2.50 in microfiche. USGS Open-File Report 82-79, 1982. 5 Sheets, 25 Ref.

Descriptors: *Aquifers, *Geohydrologic units, *Groundwater, Water table, Groundwater level, *Maps, Irrigation wells, Well yield, Hydrologic data, *Kansas, Republican River basin.

Principal aquifers in the Republican River basin in Kansas are unconsolidated alluvial deposits. One such aquifer is formed by the Ogallala Formation of Miocene age which covers most of the western part of the area. Because saturated thickness of the aquifer decrease northeastward, maximum yields to irrigation wells decrease in that direction from 2,000 to 500 gallons per minute. The Grand Island Formation of Pleistocene age occurs in an ancestral channel of the Republican River in northeast Jewell and northwest Republic counties. The maximum yield to wells from this aquifer was estimated to be 2,000 gallons per minute. Quaternary alluvium of Pleistocene and Holocene age occurs in most major stream valleys. The aquifer in the Republican River valley yields as much as 2,000 gallons per minute to irrigation wells. Water levels in the Ogallala Formation commonly declined from 5 to 40 feet during 1950-77 as a result of irrigation withdrawals. Recharge from irrigation by stream diversions have raised water levels as much as 25 feet in the Grand Island Formation and as much as 15 feet in the Quaternary alluvium of the Prairie Dog Creek valley. (USGS)
W84-00549

POSITION OF THE SALTWATER-FRESHWATER INTERFACE IN THE UPPER PART OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA, 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. D. Fretwell.
USGS Open-File Report 82-90 (WRI), 1982. 1 Sheet, 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Observation wells, *Saline-freshwater interfaces, Aquifers, Monitoring, Groundwater management, Water consumption, Limestone, *Florida, Floridan aquifer.

The position of the saltwater-freshwater transition zone in the Floridan aquifer along coastal southwest Florida is depicted by the 250 milligram per liter line of equal chloride concentration in the upper producing zone of the aquifer. The line was interpolated from chloride concentration data for wells open to the upper producing zone of the aquifer and plotted on a map having a scale of 1:250,000. The line generally lies inland within 5 miles of the coast in areas extending from latitude 29 degrees in Citrus County southward to southern Hillsborough County. In Manatee and Sarasota Counties, the line generally lies with 2 miles of the coast, except in southern Sarasota County where it extends eastward along the Charlotte-DeSoto County line. Knowledge about the position and movement of the 250 milligram per liter line is significant in the effective management of the ground-water resources of coastal areas. The present position of the line will be used as a basis for detecting future movement of the saltwater-freshwater interface. (USGS)
W84-00550

THICKNESS OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1179 (WRI) 1982. 1 Sheet, 2 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, Geologic faults, *Southeastern United States.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and that are hydraulically connected in varying degrees. A map is presented that shows the thickness of the upper permeable zone of the aquifer system. Several types of geologic structures have had an effect on the thickness of the upper permeable zone. The magnitude of this effect varies with the type and size of the structure. (USGS)
W84-00551

SOURCES OF COMPUTER PROGRAMS IN HYDRAULICS.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY5, p 915-922, May, 1980.

Descriptors: *Computer programs, *Mathematical models, *Bibliographies, Publications, Documentation, Hydraulic engineering.

A list is presented of bibliographies and other publications that enumerate mathematical, numerical, and computer models of use to hydraulic engineers. The first part of the list contains sources that are in the form of a formal publication. The second part is composed of ad hoc lists prepared at the request of the Task Committee on Computational Hydraulics or informal lists made for previous projects. Although many computer programs exist, the number of lists and bibliographies is rather small. Thus, the list presented is not exhaustive. (Small-FRC)
W84-00581

TOTAL HARDNESS OF WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
C. L. Sprinkle.
USGS Open-File Report 81-1102 (WRI), 1982. 1 Sheet, 16 Ref.

Descriptors: *Groundwater, *Aquifers, *Hardness, Limestone, Carbonate rocks, Groundwater movement, Geohydrology, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and are hydraulically connected in varying degrees. The upper part of the aquifer system consists primarily of the Tampa, Suwannee, Ocala, and Avon Park Limestones. Based on analyses of water samples from 661 selected wells, a map is presented which shows total hardness in ranges of 0-60, 61-120, 121-180, and greater than 180 mg (as calcium carbonate). Most of the area mapped has water that is hard (121-180 mg) to very hard (greater than 180 mg). (USGS)
W84-00595

SULFATE CONCENTRATION IN WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
C. L. Sprinkle.
USGS Open-File Report 81-1101 (WRI), 1982. 1 Sheet, 28 Ref.

Descriptors: *Groundwater, *Aquifers, *Sulfates, Limestone, Carbonate rocks, Groundwater movement, Geohydrology, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and are hydraulically connected in varying degrees. The upper part of the aquifer system consists primarily of the Tampa, Suwannee, Ocala, and Avon Park Limestones. Based on analyses of water samples from 661 selected wells, a map is presented which shows sulfate concentration in ranges of 0-50, 51-100, 101-250, and greater than 250 mg. Areas of high sulfate concentration are discussed in relation to the predevelopment and modern-day ground-water flow system. (USGS)
W84-00596

THICKNESS OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1124 (WRI), 1982. 1 Sheet, 2 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and that are hydraulically connected in varying degrees. A map is presented that shows the thickness of the aquifer system. Several types of geologic structures have had an effect on the thickness of the system. The magnitude of this effect varies with the type and size of the structure. (USGS)
W84-00597

GEOLOGY AND CONFIGURATION OF THE BASE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1176 (WRI), 1982. 1 Sheet, 5 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, Geologic fractures, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age land that are hydraulically connected in varying degrees. A map is presented that shows at the altitude and configuration of base of the aquifer system. The age and lithology of the different low-permeability materials that mark the base of the system are delineated and briefly described. Several types of geologic structures that affect the configuration of the base of the system may be readily recognized. (USGS)
W84-00598

CONFIGURATION OF THE BASE OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1177, (WRI), 1982. 1 Sheet, 8 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, Geologic faults, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and that are

ally connected in varying degrees. The stem consists, in large part, of two major e zones separated by a less-permeable nap is presented that shows the altitude guration of the base of the upper perme- of the system; and the age and lithology fferent low permeability materials that base are delineated and briefly described. ypes of geological structures that affect guration of the base of the upper perme- may be readily recognized. (USGS) 09

GY AND CONFIGURATION OF THE F THE TERTIARY LIMESTONE R SYSTEM, SOUTHEASTERN STATES,
al Survey, Atlanta, GA. Water Resources

er.
pen-File Report 81-1178 (WRI), 1982. 1 Ref.

ors: *Groundwater, *Aquifers, Carbonate mestone, Geohydrology, Geologic faults, stern U.S., *Maps.

tiary limestone aquifer system of the ern United States is a thick sequence of e rocks that vary in age and that are ally connected in varying degrees. A map ed that shows the altitude and configura- e top of the aquifer system, as well as the the youngest rock that is judged to be e system. Several types of geologic struc- affect the configuration of the top of the ay be readily recognized. (USGS) 00

LOGIC DATA FOR URBAN STUDIES HOUSTON, TEXAS, METROPOLITAN 979,
al Survey, Houston, TX. Water Re- Div.
n, J. F. Weigel, and J. P. Bruchmiller.
Open-File Report 82-164, February 1982, Fig, 18 Tab, 6 Ref.

ors: *Rainfall-runoff relationship, Storm treamflow, *Data collections, *Urban hy- data, Houston, *Texas.

ort contains rainfall and runoff data col- uring the 1979 water year for drainage the Houston, Texas, metropolitan area. rmation will be useful in determining the o which progressive urbanization will e yield and mode of occurrence of storm Rainfall-runoff computations are presented storm periods during the 1979 water year. 02

LOGIC DATA FOR URBAN STUDIES DALLAS, TEXAS, METROPOLITAN 1979,
cal Survey, Fort Worth, TX. Water Re- Div.
Wood, H. S. Butler, and J. D. Benton.
Open-File Report 81-491, April 1981, 147 p, 8 Tab, 10 Ref.

tors: *Rainfall-runoff relationship, Storm Streamflow, *Data collections, *Urban hy- Dallas, Dallas County, *Texas.

port contains rainfall and runoff data col- during the 1979 water year for drainage of Joes Creek, Bachman Branch, Turtle Coombs Creek, Cedar Creek, White Rock Elam Creek, Fivemile Creek, Whites Prairie Creek, Tenmile Creek, Buck and South Mesquite Creek in the Dallas olitan area. The information will be useful rmining the extent to which progressive ation will affect the yield and mode of nce of storm runoff. Rainfall-runoff compu- are presented for eight storm periods during 9 water year. The report for the 1979 water mpletes the Dallas urban project. Hydro- logic data contained in this report and in all previous reports of the Dallas and Fort Worth metropolitan areas are being used to prepare an interpretive report entitled 'Effects of urbanization on floods in the Dallas and Fort Worth, Texas, metropolitan areas,' which will be released in 1981. (USGS)
W84-00603

COMPILATION OF SELECTED GROUND-WATER-QUALITY DATA FROM THE SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225, Price: $36.25 in paper copy, $3.50 in microfiche.

Descriptors: *California, Groundwater, Water wells, Water analysis, Water chemistry, *Data collections, Water quality, San Joaquin Valley.

The Central Valley of California is one of the most notable structural depressions in the world. It is surrounded by mountains and filled with alluvium derived from those mountains. The San Joaquin Valley is the southern two-thirds of the Central Valley and is bordered on the east by the Sierra Nevada, on the west by the Coast Ranges, on the north by the Sacramento-San Joaquin River Delta area, and on the south by the Tehachapi Mountains. The San Joaquin Valley is probably most noted for its intensive agricultural development, and boasts one of the greatest agricultural economies in the world. The development of ground water has been important to this agricultural boom and subsequently the chemical quality of the ground water is of great interest, especially with respect to maximum agricultural yields as well as domestic uses. This report compiles and summarizes the ground-water-quality data published by the U.S. Geological Survey since about 1950. It includes analyses from more than 5,200 wells. The scope of the study includes the evaluation of the distribution of the water-quality sample by time, aquifer, and area. The distribution is complicated by inconsistencies of sampling with time and area, so time-trend analysis is difficult in most of the area. (USGS)
W84-00604

ANALYSES OF NATIVE WATER, BOTTOM MATERIAL, ELUTRIATE SAMPLES AND DREDGED MATERIAL FROM SELECTED SOUTHERN LOUISIANA WATERWAYS AND SELECTED AREAS IN THE GULF OF MEXICO, 1979-81,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. L. Lurry.
USGS Open-File Report, 82-690, 1983, 300 p, 11 Fig, 16 Tab, 15 Ref.

Descriptors: *Dredging, *Louisiana, Biochemical oxygen demand, Waste disposal, Effluents, Environmental effects, Nutrients, Pesticides, Trace elements, *Water quality, *Gulf of Mexico, Lower Mississippi River, *Calcasieu River, Mississippi River Gulf Outlet, Intracoastal Waterway, New Orleans to Venice Hurricane Protection Project, *Elutriate.

The U.S. Geological Survey was requested by the U.S. Army Corps of Engineers, New Orleans District, to provide water-quality data to evaluate environmental effects of dredging activities in selected reaches of the Calcasieu River in southwestern Louisiana. Samples were collected from the upper and lower Calcasieu River between January 1980 and March 1981. Thirty-three samples (22 native-water and 11 effluent) were collected from eleven dredging sites. In addition, a series of elutriate studies were conducted between July 1979 and July 1981 to determine water quality as a basis for assessing possible environmental effects of proposed dredging activities in the following areas: Grand Bayou and Martins Canal near Happy Jack, unnamed bayou near Port Sulphur, Grand Bayou and Pipeline Canal near Port Sulphur and Bayou des Plantins near Empire; Mississippi River Gulf Outlet and Inner Harbor Navigation Canal; Southwest Pass; Barataria Bay; Atchafalaya Bay at Eugene Island; Calcasieu Ship Channel. Samples of native water and samples of bottom material were collected from 22 different sites and elutriate (mixtures of native water and bottom material) samples were prepared and analyzed. Four proposed ocean-disposal sites were sampled for bottom material only. Samples were analyzed for selected chemical and biological constituents and physical properties. (USGS)
W84-00605

GROUND-WATER DATA FOR SELECTED COAL AREAS IN WESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
J. D. Wald, and S. W. Norbeck.
USGS Open-File Report 83-219, Feb. 1983, 222 p, 13 Fig, 12 Tab, 25 Ref.

Descriptors: *Groundwater, Chemical analysis, *Driller logs, Maps, Data collections, *North Dakota, Fort Union Coal Region.

Ground-water data are provided for the Sand Creek-Hanks, New England-Mott, Dickenson, and Bowman-Gascoyne coal areas, western North Dakota. The report contains the following: (1) Maps showing the location of wells, springs, and test holes; the location of test holes; where driller' logs are available; and the location of wells with chemical analysis; and (2) tables showing well, spring, and test hole records; logs; and chemical analyses of water. (USGS)
W84-00606

HYDROLOGY OF AREA 42, WESTERN REGION, INTERIOR COAL PROVINCE, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
C. T. Bryant, F. P. Lyford, K. L. Stafford, and D. M. Johnson.
USGS Water Resources Investigations, Open File Report 82-636, Jan. 1983, 87 p, 46 Fig, 13 Tab, 28 Ref.

Descriptors: *Coal mining, *Strip mines, Hydrologic aspects, Water quality, Surface waters, Subsurface waters, *Arkansas, *Interior coal province, Arkansas Valley coal region, *Arkansas River Basin.

This report is one of a series presenting general hydrologic information in selected coal-mining basins and is designed to be useful to mine owners and operators and consulting engineers in the preparation of requests for mining permits. The western region of the Interior Coal province is divided into seven hydrologic assessment reporting areas. This report is for area 42, located at the southern end of the province, in the Interior Highlands of West-Central Arkansas. The U.S. Geological Survey in this area operates (1981) a network of 20 hydrologic data collection stations to monitor the stream flow. Data collected include rate of flow and water quality information. This report presents data from this effort as well as analyses and interpretations of this and other pertinent data descriptive of the hydrology. (USGS)
W84-00607

HYDROLOGIC DATA FOR URBAN STUDIES IN THE AUSTIN, TEXAS, METROPOLITAN AREA, 1981,
Geological Survey, Austin, TX. Water Resources Div.
R. M. Slade, Jr., J. E. Veenhuis, M. E. Dorsey, H. Gardiner, and A. E. Smith.
USGS Open File Report 83-44, 1983, 309 p, 17 Fig, 21 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationship, Storm runoff, Streamflow, Hydrographs, Mass curves, Hydrologic data, *Data collections, *Urban areas, Water quality, Austin, *Texas, Colorado River(Tex), Balcones Escarpment, Edwards aquifer.

Rainfall and runoff data collected during the 1981 water year for the Austin, Texas metropolitan area are reported. In 1975, the program was expanded to include the collection of water-quality data. In 1978, the program was expanded to include a ground-water resources study of the south Austin metropolitan area in the Balcones Fault Zone. The information will be useful in determining the effect of urbanization on flood peaks, volume, and water quality. The major streams in the study area are Onion Creek, Baron Creek, Walnut Creek, Bull Creek, Boggy Creek, Shoal Creek, Williamson Creek, Slaughter Creek, Bear Creek, and Waller Creek. All streams in the area are within the Colorado River basin. Detailed rainfall-runoff computations are presented for several storms during the 1981 water year. Water-quality data for sites in the Austin metropolitan area are also given in this report. (USGS)
W84-00608

DEVELOPMENT OF GROUND-WATER RESOURCES IN ORANGE COUNTY TEXAS, AND ADJACENT AREAS IN TEXAS AND LOUISIANA, 1971-80,
Geological Survey, Austin, TX. Water Resources Div.
C. W. Bonnet, and R. K. Gabrysch.
USGS Open-File Report 82-330, 1982. 57 p, 11 Fig, 5 Tab, 18 Ref.

Descriptors: *Groundwater, *Aquifers, *Water levels, Drillers logs, Observation wells, Chemical analyses, Saline water encroachment, Chlorides, Pumpage, Land-surface subsidence, Orange County, *Texas, Louisiana.

The major water-bearing unit in the study area is the Chicot aquifer. The Chicot aquifer overlies the Evangeline aquifer. The Evangeline aquifer is undeveloped in Orange County, but is developed at Evadale in Jasper County, Texas, and at Silsbee in Hardin County, Texas. Both aquifers consist of unconsolidated and discontinuous layers of sand and clay that dip toward the Gulf of Mexico. Pumpage in Orange County from the lower unit of the Chicot aquifer averaged 21.2 million gallons per day and pumpage from the upper unit of the Chicot averaged about 2 million gallons per day from 1971-79. Pumpage increased in municipal areas and decreased in industrial areas with little net change in total pumpage during the report period. Most water levels continued to decline in Orange County, generally at a slower rate than before 1971. Water levels tended to stabilize in areas where ground-water withdrawals decreased. In some of the areas water levels rose. Bench-mark elevations determined during 1973 show regional land-surface subsidence from 1918-73, generally attributed to ground-water development, to be less than 0.5 foot. Locally, subsidence due to production of oil, gas, saltwater, or sulphur was about 15 feet at Spindletop Dome, Jefferson County, Texas, and as much as 3 feet (.9 meter) near Port Acres gas field, Jefferson County, Texas. Although saltwater encroachment is evident in parts of southern Orange County, the encroachment is not expected to increase because artesian pressure is unlikely to be decreased further due to stable ground-water pumping and a projected increase in the use of surface water to meet future demands. (USGS)
W84-00610

AVAILABILITY AND QUALITY OF WATER FROM THE DAKOTA AQUIFER, NORTHWEST IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
M. R. Burkhart.
USGS Open-File Report 82-264, (1982). 118 p, 11 Fig, 5 Tab, 15 Ref.

Descriptors: *Iowa, *Aquifer, *Water quality, Irrigation, Sulfates, Dakota aquifer, *Water availability.

The Dakota aquifer in northwest Iowa consists of sandstones in the Dakota Formation. Sandstone beds are from less than 10 to more than 150 feet thick and cumulatively total more than 200 feet throughout much of the area. The aquifer is confined by shale, carbonate rocks, till and loess. Water flows from the north-central part of the area to the south and southwest. Recharge is through leakage from above. Discharge is to underlying aquifers and alluvium along the Missouri and Big Sioux Rivers. An average hydraulic conductivity of 300 gallons per day per foot squared was used to estimate potential yield to wells. Yields of more than 350 gallons per minute can be commonly expected and more than 1000 gallons per minute can be produced in some areas. The quality of water from the Dakota is a calcium-magnesium-sulfate type which is generally suitable for irrigation. Water quality may be locally altered by leakage from the underlying Paleozoic aquifers if withdrawals reverse the natural flow from the Dakota into the Paleozoic. Such a reversal may exist around the City of LeMars. The presence of radionuclides exceeds recommended limits at several sites. (USGS)
W84-00611

DRAINAGE DIVIDES, MASSACHUSETTS--HUDSON RIVER BASIN, BOSTON, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
S. Wandle, Jr.
USGS Open-File Report 81-1199, 1982. 2 p, 5 Maps.

Descriptors: *Drainage basins, Surface waters, *Massachusetts, *Hydrologic data, *Maps, Data collections, Hudson River, Northern Berkshire County.

Drainage boundaries for selected subbasins in northern Berkshire County, Massachusetts, are delineated on five topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for rivers where the drainage area is greater than 3 square miles. Successive sites are indicated where the intervening area is at least 6 square miles on tributary streams and 10 square miles along the Hoosic or North Branch Noosic Rivers. (USGS)
W84-00612

GROUND-WATER RESOURCES IN THE HOOD BASIN, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00613

GROUND-WATER PUMPAGE IN NASSAU COUNTY, LONG ISLAND, NEW YORK, 1920-77, INTRODUCTION AND USER'S GUIDE TO THE DATA COMPILATION,
Geological Survey, Syosset, NY. Water Resources Div.
C. Kilburn.
USGS Open-File Report 81-499, 1982. 25 p, 2 Maps, 2 Tab, 1 Ref.

Descriptors: *Groundwater, *Withdrawal, *Well data, *New York, Nassau County, Long Island, *Ground-water pumpage.

Pumpage data from about 2,100 wells used for public and nonpublic water-supply in Nassau County from 1920-77 have been collected and are available for public inspection at the U.S. Geological Survey office in Syosset, Nassau County. Except for wells in use before 1920, these data constitute the entire record available through 1977. The data are divided into two categories--pumpage from wells used for public supply, and pumpage from wells used mainly for industrial and commercial uses, designated as nonpublic water supply. Pumpage is tabulated by well or well field and is given by month or year with an annual total. The report serves as an introduction and user's manual to the data, which are available for inspection but are not included in the report because they fill several hundred pages. The report describes the method of reporting pumpage on Long Island and how pumpage values were derived from records. It also includes well-completion data two maps showing the location of all (USGS)
W84-00614

GROUND-WATER DATA FOR GEORGIA,
Geological Survey, Doraville, GA. Water sources Div.
For primary bibliographic entry see Field 2F.
W84-00615

RECORDS OF WATER LEVELS IN THE SIOUX AQUIFER, MINNEHAHA COU SOUTH DAKOTA, 1981,
Geological Survey, Huron, SD. Water Reso Div.
D. R. Winter.
Available from the OFSS, USGS Box 25425, Ctr. Denver CO 80225, Price: $3.50 in paper $3.50 in microfiche. USGS Open-File Repo 1020, 1983. 25 p, 2 Fig, 1 Tab, 1 Ref.

Descriptors: *Data collection, *Hydrologic *Water levels, Water wells, *South Dakota, nehaha County, Big Sioux aquifer.

Water levels in the Big Sioux aquifer measur the U.S. Geological Survey in 1981 are pres in tabular and graphic form. (USGS)
W84-00649

QUALITY-OF-WATER DATA AND STAT CAL SUMMARY FOR SELECTED C MINED STRIP PITS IN CRAWFORD CHEROKEE COUNTIES, SOUTHEAST KANSAS,
Geological Survey, Lawrence, KS. Water sources Div.
L. M. Pope, and A. M. Diaz.
Available from the OFSS, USGS Box 25425, Ctr. Denver CO 80225, Price: $3.50 in paper $1.00 in microfiche. USGS Open-File Repor 1021, 1982. 29 p, 4 Fig, 6 Tab, 8 Ref.

Descriptors: *Water quality data, *Strip m Statistical analysis, Regression analysis, Water lution, Crawford County, Cherokee Cou *Kansas.

Quality-of-water data, collected October 2 1980, and a statistical summary are presented 42 coal-mined strip pits in Crawford and Cher Counties, Southeastern Kansas. The statistical mary includes minimum and maximum obse values, mean, and standard deviation. Simple li regression equations relating specific conducta dissolved solids, and acidity to concentration dissolved solids, sulfate, calcium, and magnes potassium, aluminum, and iron are also presen (USGS)
W84-00650

CONFIGURATION OF THE WATER TAB MARCH 1980, IN THE SNAKE RIVER PL REGIONAL AQUIFER SYSTEM, IDAHO A EASTERN OREGON,
Geological Survey, Boise, ID. Water Resou Div.
G. F. Lindholm, S. P. Garabedian, G. D. Newt and R. L. Whitehead.
Available from the OFSS, USGS Box 25425, Ctr. Denver CO 80225, Price: $2.25 in paper c $1.00 in microfiche. USGS Open-File Re (Map), 1983. 1 p, 1 Fig.

Descriptors: *Water table, *Aquifer syste Groundwater movement, Snake River Pl *Idaho, *Oregon, *Water levels, Regional stud *Maps.

A regional map of the water table in the Sn River Plain, Idaho and Eastern Oregon, drawn from about 1,600 water-level measurem made in March 1980. Contour intervals are 50, and 200 feet. In most of the plain, the regio aquifer is unconfined; however, in places, w occurs under semiconfined to confined conditi Where confined, variations in head with depth

within the range of the contour interval. The vas prepared as part of the Snake River Plain A (Regional Aquifer System Analysis) study. 00651

ORIDE CONCENTRATION IN WATER M THE UPPER PERMEABLE ZONE OF TERTIARY LIMESTONE AQUIFER EM, SOUTHEASTERN EASTERN ED STATES,
ogical Survey, Atlanta, GA. Water Resources

Sprinkle.
S Open-File Report 81-1103 (WRI), 1982. 1 , 29 Ref.

riptors: *Groundwater, *Aquifers, *Chlor- Limestone, Carbonate rocks, Groundwater ment, Geohydrology, *Southeast U.S.

Tertiary limestone aquifer system of the eastern United States is a thick sequence of nate rocks that vary in age and are hydrauli- connected in varying degrees. The upper part e aquifer system consists primarily of the a, Suwannee, Ocala, and Avon Park Limes- . Based on analyses of water samples from 661 ed wells, a map is presented which shows ide concentration in ranges of 0-250, 251-500, ,000, and greater than 1,000 mg/. Areas of chloride concentration are discussed in rela- to the predevelopment and modern-day id-water flow system. (USGS) 00652

OLVED-SOLIDS CONCENTRATION IN ER FROM THE UPPER PERMEABLE E OF THE TERTIARY LIMESTONE IFER SYSTEM, SOUTHEASTERN TED STATES,
ogical Survey, Atlanta, GA. Water Resources

Sprinkle.
S Open-File Report 82-94 (WRI), 1982. 1 t, 30 Ref.

riptors: *Groundwater, *Aquifers, *Dissolved s, Limestone, Carbonate rocks, Groundwater ement, Geohydrology, *Southeast U.S.

Tertiary limestone aquifer system of the neastern United States is a thick sequence of onate rocks that range from Paleocene to Mio- in age and are hydraulically connected in ing degrees. The upper permeable zone of the fer system consists of the Tampa, Suwannee, a, and Avon Park Limestones. Based on anal- of water samples from 591 selected wells, a is presented which shows dissolved-solids centration in ranges of 0-250, 251-500, 501- 0, and greater than 1,000 mg/. Dissolved-solids centrations and hydrochemical facies devel- within the aquifer system are related to the levelopment and modern-day ground-water system. (USGS) -00653

CKGROUND HYDROLOGIC INFORMA- N IN POTENTIAL LIGNITE MINING EAS IN MISSISSIPPI, JULY 1982,
logical Survey, Jackson, MS. Water Resources

Kalkhoff.
GS Open-File Report 83-257, 1983. 25 p, 3 Fig, ab, 4 Ref.

criptors: *Water quality, *Lignite, *Mining, d use, *Mississippi, Oktibbeha County, Choc- County, Noxubee County, Winston County.

water-quality sampling program was initiated in 0 to determine background hydrologic data in ential lignite mining areas of Mississippi. This ort is the third in a planned five-part series to vide data to assess future impacts of mining on ll streams. The data indicates that most streams he study area have a dissolved-solids concentra- n less than 100 mg/. The major ion concentra- ns were generally less than 10 mg/. Concentra- ns of arsenic, cadmium, mercury, and selenium in bottom material samples were below detectable limits. Cobalt, lead, zinc, copper, and chromium concentrations exceeded 10 micro-/g at all sites and maganese exceeded 1000 micro-/g at five sites. (USGS)
W84-00654

FLOODS FROM SMALL DRAINAGE AREAS IN ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
S. H. Jones.
USGS Open-File Report 83-258, 1983. 54 p, 22 Fig, 5 Tab, 17 Ref.

Descriptors: Floods, Flood characteristics, *Flood hydrographs, *Flood peaks, Flood frequency, *Drainage areas, *Data collections, *Alaska, Crest-stage gages.

Flood peak-stage and associated discharge data collected since 1963 in small (generally less than 100 square miles) drainage areas in Alaska are presented in tabular and graphical form. The report also contains table of computed magnitudes of floods at selected recurrence intervals (2, 5, 10, 25, and 50 years) for sites having 10 or more years of record. Data have been collected at approximately 125 sites since the 'small-streams program' began in 1963; 64 crest-stage gages and 3 continuous recording gages are being operated in 1983. (USGS)
W84-00659

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2B: SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-244277, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report FL-81-2B, 1982. 376 p, 17 Fig, 1 Tab.

Descriptors: *Florida, *Hydrologic data, Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections, South Florida.

Water resources data for the 1981 water year in Florida consists of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, periodic stage for 82 streams, peak discharge for 78 streams, and peak stage for 55 streams; continuous or daily elevations for 77 lakes, periodic elevations for 144 lakes; continuous ground water levels for 488 wells, and periodic ground water levels for 525 wells; and miscellaneous water level measurements for 2,317 wells; quality of water data for 444 surface water sites and 613 wells. The data for south Florida includes continuous or daily discharge for 84 streams, periodic discharge for 2 streams, peak discharge for 2 streams, continuous or daily stage for 21 streams, and periodic stage for 47 streams; continuous elevations for 15 lakes, and periodic elevations for 6 lakes; continuous ground water levels for 183 wells, periodic ground water levels for 160 wells, and miscellaneous water level measurements for 544 wells; quality of water for 146 surface water sites and for 269 wells. (USGS)
W84-00660

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2A: SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-244269, Price codes: A21 in paper copy, A01 in microfiche. USGS Water-Data Report FL-81-2A, 1982. 483 p, 14 Fig, 1 Tab. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Florida, *Hydrologic data, *Surface water, Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections, South Florida.

Water resources data for the 1981 water year in Florida consists of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, peak discharge for 78 streams, and peak stage for 55 streams; continuous or daily elevations for 77 lakes, periodic elevations for 144 lakes; continuous ground water levels for 488 wells, and periodic ground water levels for 525 wells; and miscellaneous water level measurements for 2,317 wells; quality of water data for 444 surface water sites and 613 wells. The data for south Florida includes continuous or daily discharge for 84 streams, periodic discharge for 2 streams, peak discharge for 2 streams, continuous or daily stage for 21 streams, and periodic stage for 47 streams; continuous elevations for 15 lakes, and periodic elevations for 6 lakes; continuous ground water levels for 183 wells, periodic ground water levels for 160 wells, and miscellaneous water level measurements for 544 wells; quality of water for 146 surface water sites and for 269 wells. (USGS)
W84-00661

WATER RESOURCES DATA--VIRGINIA, WATER YEAR 1982,
Geological Survey, Richmond, VA. Water Resources Div.
B. J. Prugh, Jr, F. J. Easton, and D. D. Lynch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-103192, Price codes: A21 in paper copy, A01 in microfiche. USGS Water Data Report VA-82-1, 1983. 460 p, 6 Fig, 3 Tab. Prepared in cooperation with the State of Virginia and with other agencies.

Descriptors: *Virginia, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1982 water year for Virginia consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 200 gaging stations; stage only at 1 gaging station; stage and contents at 10 lakes and reservoirs; water quality at 32 gaging stations and 8 wells; and water levels at 59 observation wells. Also included are data for 73 crest-stage partial-record stations. Locations of these sites are shown. Additional water data were collected at various sites not involved in the systematic data-collection program. Discharge measurements were made at 41 coal-monitoring partial-record stations and at 199 low-flow partial-record station. Miscellaneous data were collected at 119 measuring sites and 94 water-quality sampling sites. (USGS)
W84-00662

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 2. EASTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-245092, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report WA-81-2, (April 1983). 276 p, 19 Fig. Prepared in cooperation with the State of Washington and with other agencies.

Descriptors: *Washington, *Hydrologic data, *Groundwater, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, Eastern Washington.

Water-resources data for the 1981 water year for the eastern region of Washington consist of

records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report, in two volumes, contains records for water discharge at 229 gaging stations; stage only at 5 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 39 gaging stations (including 6 lakes and reservoirs) and 100 wells; and water levels at 164 observation wells. Also included are data for 14 crest-stage and 28 water-quality partial-record stations. Locations of sites in this volume are shown. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-00663

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 1. WESTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-245084. Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report WA-81-1, (April 1983). 337 p, 22 Fig. Prepared in cooperation with the State of Washington and with other agencies.

Descriptors: *Washington, *Hydrologic data, *Groundwater, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, Western Washington.

Water-resources data for the 1981 water year for the western region of Washington consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of groundwater wells. This report, in two volumes, contains records for water discharge at 229 gaging stations; stage only at 5 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 39 gaging stations (including 6 lakes and reservoirs) and 100 wells; and water levels at 164 observation wells. Also included are data for 14 crest-stage and 28 water-quality partial-record stations. Locations of sites in this volume are shown. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-00664

WATER RESOURCES DATA FOR ARIZONA, 1981.
Geological Survey, Tucson, AZ. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243907, Price codes: A23 in paper copy, A01 in microfiche. USGS Water-Data Report AZ-81-1, (February 1983). 532 p., 8 Fig. Prepared in cooperation with the State of Arizona and with other agencies.

Descriptors: *Arizona, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Arizona consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water levels of observation wells; and quality of ground water. This report contains discharge records for 237 gaging stations, annual peaks for 41 crest-stage partial-record stations, and discharge measurements at 90 miscellaneous sites; contents only records for 9 lakes and reservoirs; stage and contents for 1 lake, elevation and discharge for 1 streamflow station; elevation only for 1 streamflow station; 16 supplementary records, included with gaging station records, consisting of monthend or monthly stage, contents, and evaporation of lakes and reservoirs, diversions, and return flows; water-quality records for 64 continuous-record stations and 5 miscellaneous sites; water levels for 104 observation wells; and water-quality data for water from 752 wells. (USGS)
W84-00665

WATER RESOURCES DATA FOR PENNSYLVANIA WATER 1981, VOLUME 1. DELAWARE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-244251, Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report PA-81-1, 1982. 327 p, 9 Fig.

Descriptors: *Pennsylvania, *Hydrologic data, *Groundwater, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, *Delaware River Basin.

Water resources data for the 1981 water year for Pennsylvania consist of records of discharge and water quality of streams; elevation and contents of lakes and reservoirs; and elevation of tides; and water levels of ground-water wells. This volume contains records for water discharge at 71 gaging stations; elevation and contents at 11 lakes and reservoirs; elevation of tides at 1 gaging station; water quality at 40 gaging stations; and water levels at 16 observation wells. Also included are data for 37 crest-stage, 90 low flow, and 43 water-quality partial-record stations. Locations of these sites are shown. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-00666

HYDROGEOLOGY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS - NORTHERN YORK AND SOUTHERN CUMBERLAND COUNTIES, MAINE,
Geological Survey, Boise, ID. Water Resources Div.
A. L. Tolman, D. H. Tepper, G. C. Prescott, Jr., and S. O. Gammon.
USGS Open-File Report 83-1, 1983. 4 Maps, 30 Ref.

Descriptors: *Areal hydrogeology, *Glacial aquifers, *Glacial sediments, *Water quality, *Groundwater pollution, Groundwater availability, Well yield, Seismology, Resistivity, Water pollution sources, Water table fluctuations, *Maps, *Maine, Northern York County, Southern Cumberland County.

This reconnaissance-level hydrogeologic study covers an area of 875 square miles in northern York and southern Cumberland Counties, Maine. This region contains the densest concentration of both aquifers and population in the State, and was selected for study in preparation for management and protection programs being developed at the State and Federal level. This map report includes: identification and mapping of boundaries of approximately 172 square miles of significant aquifers; estimated aquifer yields; depth to water table; depth to bedrock/thickness of unconsolidated deposits; bedrock surface topography; stratigraphy and stratigraphic relationships; characterization of regional ground-water chemistry; and assessments of the effects of 37 potential contamination sites on ground-water quality. The aquifers within the study area are typically less than 50 feet thick, become finer-grained with depth, and are underlain by marine deposits or till. About 10 square miles of the aquifers studied can sustain well yields of more than 50 gallons per minute but few of these aquifers are capable of yielding quantities sufficient for industrial or municipal water supplies. The regional ground-water, based on samples from 23 wells, has the following chemical characteristics: it is slightly acidic to neutral; has less than 100 milligrams per liter of dissolved solids; sodium, calcium, and magnesium are the dominant cations; bicarbonate is the solids; sodium, calciu
magnesium are the dominant cations; bica
is the dominant anion; and the water is so
regional ground-water quality is excellent b
centrations of iron and manganese are high
in some localities to limit the practical use
water without treatment. Although none o
ground-water contamination sites investiga
a severe impact on ground-water quality,
mulative impacts of these sites may have
significance. (USGS)
W84-00667

**POTENTIOMETRIC SURFACE OF THE
IDAN AQUIFER IN CENTRAL SU
COUNTY, FLORIDA, MAY 1982,**
Geological Survey, Tallahassee, FL. Wat
sources Div.
L. A. Bradner.
USGS Open-File Report 83-41, 1983. 1 p,

Descriptors: Potentiometric level, *Ground
Hydrologic aspects, *Aquifer, Hydroge
*Maps, *Sumter County, *Florida.

This map presents the potentiometric surface
Floridan aquifer in central Sumter County,
ida, for May 1982. The Floridan aquifer
principal source of potable water in the are
focus of the map is the potentiometric sur
the Jumper Creek Canal area for the low
level period. Water-level measurements were
at approximately 60 wells. The potentiometr
face ranged in altitude from more than 95
the southeast part of the county to less than
northwest of Lake Panasoffkee in the west-c
area. (USGS)
W84-00668

**POTENTIOMETRIC SURFACE OF THE F
IDAN AQUIFER, SOUTHWEST FLO
WATER MANAGEMENT DISTRICT,
1982,**
Geological Survey, Tallahassee, FL. Wate
sources Div.
G. L. Barr, and G. R. Schiner.
Available from the OFSS, USGS Box 25425
Ctr. Denver CO 80225, Price: $1.75 in paper
$1.00 in microfiche. USGS Open-File Repo
697, May 1982. Map, 1 Fig, 2 Ref.

Descriptors: *Potentiometric level, *Potent
tric flow, Hydrology, Hydrogeology,
levels, *Maps, *Florida, Southwest Florida
Management District.

A May 1982 potentiometric surface map o
Southwest Florida Water Management Distri
picts the annual low water-level period.
levels in most wells measured in May 1982
lower than in September 1981. Levels ave
about 9 feet lower in the southern part of the
and 1.5 feet lower in the north. In agricu
areas of southern Hillsborough, Manatee, s
western Polk, southern Hardee, northwester
Soto, and northern Sarasota Counties, water-
declines ranged from 5 feet to 29 feet. From
1981 to May 1982, water-level increases ra
from about 3 feet in the northern counties to
20 feet in the middle and southern counties. W
level increases were about 4 feet in the ext
southern part of the study area. (USGS)
W84-00669

**APPLICATIONS SYSTEMS VERIFICAT
AND TRANSFER PROJECT, VOL. II, OF
ATIONAL APPLICATIONS OF SATELL
SNOW-COVER OBSERVATIONS AND DA
COLLECTION SYSTEMS IN THE ARIZ
TEST SITE,**
Geological Survey, Phoenix, AZ. Water
sources Div.
H. H. Schumann.
National Aeronautics and Space Administra
Technical Paper 1823, December 1981. 80 p
Fig, 9 Tab, 22 Ref.

Descriptors: *Snow cover, *Snowmelt-ru
*Satellite remote sensing, Remote sensing, *S
lite data collection, *Telemetry, Hydrol

, Satellites-meteorology, Runoff-prediction
, *Arizona, Arizona test site, Salt-Verde
ned.

peration of multipurpose reservoirs in se-
central Arizona requires timely and depend-
reamflow and snowmelt information. Since
onventional ground surveys and aerial ob-
ons have been used in an attempt to monitor
changing moisture conditions in the Salt-
watershed. Since 1974, repetitive satellite
over observations have greatly reduced the
ty for frequent routine aerial snow-recon-
ce flights over the mountains. Although
types of satellite imagery can provide the
c coverage necessary to map the large
overed areas in the 34,000-square-kilometer
ned, frequent repetitive coverage is required
itor the rapid changes in snow cover. High-
on (80 meter) multi-spectral imagery pro-
by the Landsat satellite series enabled rapid
curate mapping of snow-cover distributions
ll- to medium-sized subwatersheds; howev-
dsat imagery provided only one observation
9 days of about a third of the watershed.
esolution 1 kilometer) imagery acquired by
OS and SMS/GOES meteorological satellite
provides the daily synoptic observation nec-
to monitor the rapid changes in snow-cov-
ea in the entire watershed. A comparison of
overed area measurements and correspond-
an daily runoff rates indicates that short-
unoff volumes can be predicted from daily
tial satellite snow-cover observations. Sea-
runoff predictions have been improved by
a modified hydrometeorological model.
0670

**R-LEVEL MAPS OF THE MISSISSIPPI
VIAL AQUIFER, NORTHWESTERN
SSIPPI, SEPTEMBER 1982,**
gical Survey, Jackson, MS. Water Resources
den.
Water-Resources Investigations Report 83-
983. 1 Map, 5 Fig, 8 Ref.

ptors: *Mississippi, *Groundwater,
er, Water levels, *Maps, Mississippi River
alluvial aquifer, Quarternary aquifers.

levels were measured in about 500 wells in
ississippi River valley alluvial aquifer in
estern Mississippi during September 13-24,
The water-level change from September
o September 1982 showed some recovery,
e depth-to-water map showed areas of con-
water-level decline in the central part of the
Water levels in the Delta were higher along
ssissippi River and Bluff Hills and Yazoo
Historically, water levels decline and rise as
ount of precipitation decreases or increases.
ly, continuous heavy pumping for irrigation
used general water-level declines in the allu-
uifer. (USGS)
0671

**TUDE AND CONFIGURATION OF THE
EVELOPMENT WATER TABLE IN THE
PLAINS REGIONAL AQUIFER,
HWESTERN OKLAHOMA,**
gical Survey, Oklahoma City, OK. Water
rces Div.
avens.
Open-File Report 82-275 (WRI), March
Sheets, 11 Ref.

ptors: *Groundwater, *Aquifers, *Water
Bedrock, *Oklahoma, *High Plains Regional
r System, *Maps.

igh Plains aquifer in Oklahoma is part of a
al aquifer system extending from South
a southward to Texas and New Mexico. The
pal aquifer, the Ogallala Formation of Terti-
ge, is hydraulically connected with other
solidated deposits, principally of Quaternary
During 1978, the U.S. Geological Survey
a 5-year study of the High Plains regional
r system to provide hydrologic information
aluation of the aquifer and to develop and evaluate predictive computer models of it. This report consists of two maps showing the altitude and configuration of the predevelopment water table in the eastern area and the Panhandle area. The water table generally sloped from west to east at an average rate of about 14 feet per mile. The altitude of the water table ranged from about 4,650 feet in Cimarron County to about 1,950 feet in Woodward County. (USGS)
W84-00672

GENERALIZED ALTITUDE AND CONFIGURATION OF THE BASE OF THE HIGH PLAINS REGIONAL AQUIFER, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
USGS Open-File Report 81-1117 (WRI) March 1982, 2 Sheets, 25 Ref.

Descriptors: *Aquifers, Bedrock, *Oklahoma, *High Plains Regional Aquifer System, *Maps.

The High Plains aquifer in Oklahoma is part of a regional aquifer system extending from South Dakota on the north to Texas and New Mexico on the south. The principal aquifer, the Ogallala Formation of Tertiary age, is hydraulically connected with other unconsolidated deposits, principally of Quaternary age. During 1978, the U.S. Geological Survey began a 5-year study of the High Plains regional aquifer system to provide hydrologic information for evaluation of the aquifer and to develop predictive computer models of it. This report consists of two maps showing the altitude and configuration of the eroded pre-Ogallala bedrock surface, the base of the aquifer. Bedrock slopes generally from west to east and is composed of rocks of Permian, Triassic Jurassic, and Cretaceous age. Altitudes of the aquifer base were determined from drillers' logs and from published and unpublished information. (USGS)
W84-00673

ALTITUDE AND CONFIGURATION OF THE 1980 WATER TABLE IN THE HIGH PLAINS REGIONAL AQUIFER, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
USGS Open-File Report 82-100 (WRI), March 1982. 2 Sheets, 6 Ref.

Descriptors: *Groundwater, *Aquifers, *Water table, Bedrock, *Oklahoma, *High Plains Regional Aquifer System, *Maps.

The High Plains aquifer in Oklahoma is part of a regional aquifer system extending from South Dakota southward to Texas and New Mexico. The principal aquifer, the Ogallala Formation of Tertiary age, is hydraulically connected with other unconsolidated deposits, principally of Quaternary age. During 1978, the U.S. Geological Survey began a 5-year study of the High Plains regional aquifer system to provide hydrologic information for evaluation of the aquifer and to develop and evaluate the predictive computer models of it. This report consists of two maps showing the altitudes and configuration of the 1980 water table in the eastern area and the Panhandle area. The water table generally slopes 14 feet per mile. The altitude of the water table ranges from about 4,650 feet in Cimarron County to about 2,000 feet in Woodward County. (USGS)
W84-00674

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from the OFSS, USGS, Lakewood, CO 80225, Paper copy $3.50; Microfiche $1.00. USGS Open-File Report 83-30, 1983. 1 p, 1 Fig.

Descriptors: *Potentiometric level, *Groundwater, Hydrologic aspects, *Aquifer, Hydrogeology, *Maps, *Florida, St. Johns River Water Management District.

This map presents the potentiometric surface of the Floridan aquifer in the St. Johns River Water Management District and vicinity for September 1982. The Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area a 40-foot interval is used to show a deep cone of depression. The potentiometric surface ranged from 131 feet above NGVD (National Geodetic Vertical Datum of 1929) in Polk County to 68 feet below NGVD in Nassau County. Water levels continued to recover from record low levels set in September 1981. Except in a few places, water levels throughout the District rose above September 1981 levels. September 1982 levels were as much as 10 feet and commonly 2 to 3 feet higher than the below normal September 1981 levels. (USGS)
W84-00675

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, SEPTEMBER 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. L. Barr, and G. R. Schiner.
Available from the OFSS, USGS, Fed. Ctr. Lakewood CO 80225, Price: $1.75 in paper copy, $1.00 in microfiche. Open-File Report (Map) 82-1011, September 1982, 1 p, 1 Fig, 2 Ref.

Descriptors: *Potentiometric level, *Potentiometric flow, Hydrology, Hydrogeology, *Maps, *Water levels, *Florida, Southwest Florida Water Management District.

A September 1982 potentiometric surface map of the Southwest Florida Water Management District depicts the annual high water-level period. Water levels in most wells measured in September 1982 were higher than in May 1982. Levels averaged about 12 feet higher in the southern part of the area and about 5 feet higher in the north. In agricultural areas of southeastern Hillsborough, Manatee, southwestern Polk, Hardee, northwestern De Soto, and northern Sarasota Counties, water-level increases ranged from 1 to 27 feet. From September 1981 to September 1982, water-level changes ranged from slight decreases in some parts of the study area to 1- to 22-foot increases in the major part of the study area. (USGS)
W84-00676

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, SEPTEMBER 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. A. Bradner.
USGS Open-File Report 83-42, 1983. 1 p, 1 Fig.

Descriptors: *Potentiometric level, *Groundwater, Hydrologic aspects, Aquifer, Hydrogeology, *Maps, Sumter County, *Florida.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Florida, for September 1982. The Floridan aquifer is principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the high water-level period. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 90 feet in the southeast part of the county to less than 40 feet northwest of Lake Panasoffkee in the west-central area.
W84-00677

SUPPLEMENT TO THE NEW MEXICO THREE-DIMENSIONAL MODEL (SUPPLEMENT TO OPEN-FILE REPORT 80-421),

Geological Survey, Albuquerque, NM. Water Resources Div.
G. A. Hearne.
USGS Open-File Report 82-857, 1982. 163 p, 5 Fig, 8 Tab, 5 Ref.

Descriptors: *Computer programs, *Documentation, *Computer models, Data processing, Groundwater, Leakage, Water table, Aquifer, Aquicludes, River, *New Mexico.

The computer program documented in Open-File Report 80-421 has continued to evolve in response to needs. By January 1981, changes included the following: (1) treatment of head-dependent boundaries and specified-flow boundaries and (2) code which executes on the CRAY-1 computer. This report provides instructions for compiling and executing the computer program on the CRAY-1 at Kirtland Air Force Base. (USGS)
W84-00678

SELECTED HYDROLOGIC DATA FOR NORTHERN UTAH VALLEY, UTAH, 1935-82,
Geological Survey, Salt Lake City, UT. Water Resources Div.
L. Appel, D. W. Clark, and P. E. Fairbanks.
USGS Open-File Report 82-1023, 1982. 94 p, 2 Fig, 8 Tab, 4 Ref.

Descriptors: Water resources, *Utah, *Groundwater, Surface water, *Water quality, Discharge, *Water levels, Water-resources data, Lehi, Provo, Orem, Utah Valley, Utah County, *Utah.

Presented are hydrologic data collected in northern Utah Valley from 1935 to 1982. The data include records of selected wells, springs, drains, irrigation ditches, streams, water quality, and drillers' logs of selected wells. Some of the data were previously published by the Geological Survey and cooperating agencies. (USGS)
W84-00681

8. ENGINEERING WORKS

8A. Structures

HYDROPOWER IN PORTUGAL: PROSPECTS FOR LARGE RESERVOIRS,
Coimbra Univ. (Portugal).
J. L. Serafim.
International Water Power and Dam Construction, Vol 35, No 2, p 40-42, February, 1983. 3 Fig, 2 Tab.

Descriptors: *Water resources development, *Reservoirs, Portugal, Rivers, Hydroelectric power, Design criteria, Cost anlysis, Economic aspects.

Areas and rivers in the country of Portugal where the most cost effective development of hydropower is likely to take place are described. The waters of rivers coming from Spain constitute a very appreciable hydraulic resource. In addition, good reservoirs and dam sites exist in paleozoic and granitic rocks, providing substantial hydroelectric resources to Portugal. The irregularities of rain and flow from the north to the south of the country, and from winter to summer and from year to year, make it appropriate to construct large reservoirs, high dams and powerful plants. The overall theoretical hydroelectric potential of the country for a year of average precipitation has been estimated as 32000 GWh, of which only about 30% is being exploited. Installed capacity is around 2300 MW in 25 large hydro plants of over 10 MW capacity. To obtain such a large amount of power, in a country of 89000 sq km area it will be necessary to build about 46 new large powerplants and dams, to increase substantially the installed capacity in at least 10 existing plants and to use around 80 small-scale systems, either existing or new, of less than 10 MW capacity. At present, because of the lack of funds, difficulties in buying inundated land, delays in international agreements and other reasons, there are only two hydropower stations under construction. (Baker-FRC)
W84-00413

PINPOINTING PIPE RUPTURES,
Compagnie Generale des Eaux, Paris (France).
A. Divenot.
Water/Engineering and Management, Vol 129, No 12, p 36-37, 1982. 4 Fig.

Descriptors: *Pipelines, *Rupturing, *Computers, Mechanical failure, Automation, Monitoring, Mathematical equations.

A method based on the use of a mathematical network model has been developed to locate ruptures in water distribution pipes quickly and accurately. It has two advantages over the established trial and error process. Not only do the automatic measurements preclude any need for human intervention, they also provide results of better quality, as they make a universal search instead of calculated point-by-point searches. Of the various data stored in a typical distribution system control computer, the most relevant are the flow rates at the supply sources and the pressures measured at the sources and in the system. The cumulative total of these flow rates is equal to the network's instantaneous consumption. Unfortunately, every process based on knowledge of the flow from a break indicated by variation of the source flows has the serious drawback of not being applicable when one of the flowrate sensors is unavailable for one reason or another. But if the search is based on pressure sensors, shutting down one or even several of them does not make the system inoperable. (Baker-FRC)
W84-00488

RECOMMENDED STANDARDS FOR WATER WORKS.
New York State Health Department Bulletin 42, Health Education Service, Albany, NY, 1982. 88 p, 1 Fig, 1 Tab.

Descriptors: *Standards, *Guidelines, *Design standards, *Specifications, *Water supply systems, *Engineering, Water supply development, Water storage, Pumping plants, Chemical treatment, Distribution.

These standards are intended to serve as 1) a guide in the design and preparation of plans and specifications for public water supply systems, 2) to suggest limiting values for items upon which an evaluation of such plans and specifications may be made by a reviewing authority, and 3) to establish, as far as practicable, uniformity of practice. The standards given are for submission of plans, general design considerations, pumping facilities, finished water storage and distribution systems. In addition, the manual contains policy statements on: 1) Package water treatment plants for public water supplies, 2) organic removal treatment for public water supplies, 3) ozonation for public water supplies, 4) distribution system corrosion control for public water supplies, and 5) salt storage for highway use and public water supplies. (Garrison-Omniplan)
W84-00501

HIGH WOOD RESERVOIR--PLANNING, DESIGN AND CONSTRUCTION,
N. C. Pasley.
Water Services, Vol 87, No 1043, p 11-12, 15-16, 18, January, 1983. 4 Fig, 2 Tab.

Descriptors: *Reservoir construction, *Soil properties, *Concrete, Water storage, Reservoir design, Design criteria, Construction, High Wood Reservoir, Excavation, *United Kingdom.

The planning, design, and construction of the High Wood Reservoir, upstream of the River Itchen, United Kingdom, is described. The 135 m liter concrete storage reservoir was built to protect the treatment works influent against gross river pollution, provide a 2 days' supply, and smooth out variations in river water quality. The foundation soil was cohesive, inorganic, and medium to highly plastic, with low coefficients of compressibility and volume change. A 600 m long, 5 m deep perimeter drain was used to dewater the site and to control the groundwater level, which was near the surface. Two grades of concrete were specified, one for the mass concrete and blinding c and the other for reinforced concrete. A 65,000 cu m of soil was excavated and inco ed into the reservoir banks. (Cassar-FRC)
W84-00563

COMMODITY PIPELINES MAY AID W DEVELOPMENT.
World Water, Vol 5, No 12, p 38-39, 41, D ber, 1982. 1 Tab.

Descriptors: *Pipelines, *Water transport, * oping countries, Transportation, Water c ance, Conduits, Slurries, Aquatrain.

The Aquatrain is a method of commodity p transport being tested by the W. R. Grace C ny. It proposes to move coal packaged in duty plastic bags and carried by high p water flow through a 1 m pipeline from m Colorado to California. Fresh water for th leg of the transport would come from the River in the Rockies. At Rifle the Yampa would be used for municipal supplies or discl into the Colorado River. Water for the rem of the line would be obtained from a saline C do tributary and be discharged, after recov the coal bags, into the Pacific. Other develo in pipeline transport include a more viscous to help keep larger particles in suspensio movement of agricultural products, such as pods. In developing countries poor roads an of railroads make the pipeline alternative tive. Commercial slurry pipelines of lengths 439 km currently move coal, limestone, ore other mineral products in the U.S. and man eign countries. (Cassar-FRC)
W84-00565

8B. Hydraulics

MAINTAINING TIDAL INLET CHANNEL FLUIDIZATION,
Lehigh Univ., Bethlehem, PA. Dept. of Civ gineering.
R. N. Weisman, A. G. Collins, and J. M. Park
Journal of the Waterway, Port, Coastal and O Division, Proceedings of the American Soci Civil Engineers, Vol 108, No WW4, p 52 November, 1982. 9 Fig, 11 Ref.

Descriptors: *Fluidization, *Channel imp ment, *Sediment control, Sand, Tidal hydra Navigation canals, Corson Inlet, *New J Pipes, Inlets.

A navigable tidal inlet channel was stabilized fluidization technique, an alternative to ch dredging. Laboratory and field studies were on a process using pipes with small holes dril frequent uniform intervals, placed in the ebb channel at a navigable depth. Water is pumpe the pipe to fluidize the sand above the pipe, is then removed by pumping, flowing do gradient, or sweeping out to sea with the ebb For sand of 0.4 mm diameter, laboratory st established a fluidization hole size of 0.31 hole spacing of 5.08 cm, and a pipe flow rate liters per sec per m of pipe (greater for diameter sands), pipe diameter of 15.2 cm, length of 12.2 m, and separation of parallel pi 1.83 m. Field tests run at Corson Inlet, Jersey, showed that the full-scale system s have a pipe spacing of 3 m with sequential p ing through pairs of parallel pipes. Problem countered were clogging of the holes with sucking of sand into the pipe, and armoring ar the pipes with clam shells. (Cassar-FRC)
W84-00580

8C. Hydraulic Machinery

LASER MEASUREMENTS FOR KAP RUNNERS,
Voith G.m.b.H., Heidenheim (Germany, F.R.)
F. L. Brand, and H. Selbach.
International Water Power and Dam Construc Vol 35, No 2, February, p 21-23, 1983. 9 F Tab.

ors: *Lasers, *Measuring instruments, eters, Data acquisition, Data collection, machinery, Hydraulic equipment, Turmps, Flow.

nced laser velocimeter with an efficient uisition system is described. The velocis been used in Germany to make measin the runner of a Kaplan water turbine. cts of laser power and scattering particles easurements are examined, and the velocoutions obtained within the blade passage ssed. Measurements were performed in a ed for testing the hydrodynamic characof different runner designs. One point of tion was the laser power needed for meas-. The output of the laser was monitored built-in power motor. The laser power in suring volume was 70% of the power at the laser output. At low light levels, fluctuations in the level of flare light or pikes in the photomultiplier tubes produce he magnitudes of which are equal to or han those of a typical particle in the water he experiments demonstrated that laser well suited for the determination of veloc- angle, and turbulence in water turbines. esults are consistent with the results ob- om Pitot static probes and theoretical con- ns. The laser measurement technique ystematic investigation of flow phenomena tor blade rows of water turbines or pumps. RC)
94

HEAD PUMP-TURBINES: FRENCH EXNCE,
Neyrpic, Grenoble (France). Electricity

ci, N. Roche, and P. Jarrland.
ional Water Power and Dam Construction, No 2, p 31-40, February, 1983. 14 Fig, 4

tors: *Turbines, *Construction, *Design Powerplants, Pumps, Mechanical equipVater resources development, Energy.

s of high-head pumped-storage plant design iewed. The advantages and disadvantages vane multi-stage turbines are considered. Clou plant, being designed in France at the time serves as an example. Details are also bout the construction of underground pen- and powerhouses for high-head pumped- plants. Several types of machines may be equip these hydroelectric powerstations: age pump-turbines with fixed, non-adjust- tributors; and single or two-stage adjustable ump-turbines. The main features of the Le rototype unit with two adjustable stages are ed including rotational speed, delivery head, delivery, turbine head, turbine output, and diameter. Design studies dealing with two- ump-turbines for the Le Clou power station sidered and characterized essentially by the of the forces involved which are: static cting on the embedded parts; and dynamic pplied in particular to the gate mechanism nents, the runner vanes, the shaft line assem- the bearings; both guide and thrust bear- or sizing the pump-turbine, knowledge of reme conditions occurring during operation ped-storage stations are considered includ- ationary parts, wicket gates, and rotating nents. Details are also included regarding tor-motors, unit starting for pumping oper- underground power station concept, and round penstocks. (Baker-FRC)
0409

URING SWIRL IN PUMP MODEL IES,
ang.
Water, Vol 5, No 12, p 42-43, December, 4 Fig.

iptors: *Pumps, *Flow pattern, *Rotational Hydraulic machinery, Impellers, Model studortices, Flow velocity.

Pump intake model studies are generally conducted with a geometrically-scaled suction pipe or siphon pipe without including a model rotation pump impeller. This assumes that the impeller has no upstream effect on the flow by adding to the approach swirl or increasng vortex activity and does not produce any prerotation. Experiments revealed that the impeller produces no prerotation from the design flow to 1.5 times the design flow. However, if pumps are to be operated at flows less than 50% of design flow, the impeller must be modeled. (Cassar-FRC)
W84-00566

PIPELINE CLEANING AND MAINTENANCE - NEW EQUIPMENT, NEW IDEAS,
R. W. Edwards.
Water Services, Vol 84, No 1013, p 418-423, July, 1980.

Descriptors: *Sewer systems, *Pipelines, *Maintenance, Cleaning, Water mains, Conveyance structures.

Technological innovations in servicing sewers and pipelines are summarized. A dual-purpose vehicle for cleaning sewers has dispensed with the separate suction unit and saves capital, operational, and maintenance costs. One crew can carry out high-pressure jetting and suction removal of deposited silt. One such unit is equipped with a jetting control panel, gauges for vacuum and air pressure, and indicators for water, sludge, and hydraulic-oil levels. This unit is built on a 16 ton chassis with a diesel engine and five speed gear box. A new relining process for water mains is the use of epoxy resin rather than the well-established practice of bitumen relining. The resin possesses many desirable features for pipes up to 30 mm in diameter. It has an estimated life of 30 years and can be applied cheaply. A major advantage of the new process is its speed. Another innovation is the use of flexible pigs for cleaning trunk mains. On a short trial run, a pig designed for 812 mm to 914 mm diameter pipes operated successfully with a pressure head of less than 1.8 m to set it in motion. (Small-FRC)
W84-00589

EFFICIENCY PERFORMANCE CRITERIA FOR IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
H. J. Hansen, and M. N. Shearer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132455, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-90, Oregon State Univ., Corvallis, November 1983. 82 p, 5 Fig, 7 Tab, 22 Ref, 13 Append. OWRT B-070-ORE(1), 14-34-0001-9157.

Descriptors: *Pump testing, *Pumping plants, *Pumps, Irrigation, Irrigation efficiency, Irrigation engineering, *Irrigation operation, Irrigation practices, *Oregon.

The efficiency performance levels of existing irrigation pumping plant systems in Oregon were determined from tests of selected systems under field operation conditions. Usable test data were obtained from 529 units out of 545 tested. The overall plant efficiency ranged from 14 to 79 percent. Twenty-eight percent of the centrifugal and 34 percent of the turbine pumping plant systems had efficiencies of 65 percent or greater. Twenty percent of the centrifugal and 23percent of the turbine units were operating under 50% efficiency. A 65% overall plant efficiency is generally considered achievable. Units under 50% efficiency generally warrant consideration for repair or replacement. The two primary causes of low overall plant efficiencies were (a) improperly designed or sized fittings around pumps (only 38% were rated satisfactory) and (b) mismatches of pump and sprinkler systems. Very often, laterals had been added, deleted or changed without making pump adjustments. Pump efficiencies ranged from 24% to 87% with 68% operating above 60% efficiency. Comparing individual pump performance with the specific manufacturer's pump curve revealed that 55% of the pumps were operating within 4% of their respective curves -- a very acceptable performance range.
W84-00593

8F. Concrete

CORROSION PROTECTION OF CONCRETE AND STEEL TANKS AND RESERVOIRS.
For primary bibliographic entry see Field 8G.
W84-00590

8G. Materials

HOW TO MAINTAIN PVC SEWER PIPE,
W. D. Nesbeitt.
Water and Pollution Control, Vol 118, No 10, p 22-25, October, 1980. 2 Fig

Descriptors: *Plastic pipes, *Maintenance costs, *Sewerage, Pipelines, Hydraulic structures, Sanitary engineering, Maintenance, Corrosion.

A review of the maintenance requirements for polyvinyl chloride (PVC) sewer pipe manufactured to meet ASTM D3034(DR35) standards is presented. The PVC sewer pipe's response to aggressive environments commonly found in gravity-flow sanitary sewer systems is evaluated, and some cost-effective maintenance procedures for PVC sewer systems are recommended. The most commonly experienced aggressive environment problems of sanitary sewer systems include root intrusion, infiltration, excessive slime accumulation, grease deposition, grit accumulation and corrosion. Tests conducted to evaluate the integrity of PVC sewer pipe gasket joints in situations of excessive deflection caused by severe earth loading showed that PVC piping with properly installed gaskets was not subject to root intrusion problems. Similarly, slime accumulation and infiltration occurred relatively infrequently in PVC sanitary sewer pipes. The greatest concern with slime accumulation is the production of sulfuric acid, which often causes pipe corrosion. PVC pipe was not usually subject to sulfuric acid corrosion. Methods of slime and grease removal by mechanical blockage removal equipment showed only slight damage, in some cases, to PVC pipes. PVC pipe is also highly resistant to abrasion in gravity systems, low in maintenance costs, and easy to install. A maintenance schedule of periodic inspection, visually or by television, and periodic preventive measures such as 'ball', rod, 'pig', or high pressure cleaning are recommended. (Geiger-FRC)
W84-00522

THE ECONOMICS OF LEAK DETECTION AND REPAIR - A CASE STUDY,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
E. E. Moyer, J. W. Male, I. C. Moore, and J. G. Hock.
Journal of the American Water Works Association, Vol 75, No 1, p 29-34, January, 1983. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Leakage, *Economic aspects, *Pipelines, *Maintenance costs, *Case studies, *Cost-benefit analysis, Water loss, Water conveyance, Pipes, Water mains, Maintenance, Water conservation.

A case study of the Westchester Joint Water Works (WJWW) in Mamaroneck, New York, is presented to demonstrate the favorable economics of systematic leak detection and repair of a water distribution system and to offer some insights into leak characteristics and the accuracy of sonic leak detection. Records of surveyors at the time of leak detection, repair crew reports and general records of water usage, costs, and unaccounted for water were reviewed in order to calculate costs and benefits in each year of leak detection. Simple statistical analysis showed that leakage stopped by WJWW saved a net amount of $239,052 over a six-year period. Leaks were classified into six categories and the net economic benefit or loss of repairing each type of leak was estimated. The accuracy of sonic leak detection in determining leak size and

location were obtained by statistically comparing survey and repair reports and the actual location of the leak with that predicted by the survey. On the whole actual and predicted leak locations correlated closely. Other possible tangible and intangible benefits of leak detection and repair include decreased damage to property, lesser loads on treatment facilities, lower total repair costs, decreased total demand, reduced risk of contamination, water conservation and decreased expenditures on leak related expenses. (Geiger-FRC)
W84-00582

CEMENT-BASED SEALS FOR THERMOPLASTIC WATER WELL CASINGS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
C. E. Kurt.
Water Well Journal, Vol 37, No 1, p 38-40, 1983. 2 Fig.

Descriptors: *Well casings, *Cement, *Construction, *Thermoplastics, Seals, Grout, Wells, Casings, Well water, Well seepage, Well regulations.

Cement-based grouts have been used to seal the annulus between the well casing and the native formation. The placement of this seal is crucial. A grout seal may be required along the entire length of the casing. In other applications only the top 10 or 20 feet of the well casing must be grouted. The purpose of these requirements is to minimize the amount of surface water that can travel through the casing annulus. When it is important that the water from one aquifer not be permitted to flow into another aquifer, only sections of the annulus need to be grouted along the length of casing. When using thermoplastic materials for water well casings the seal provides another very important function. While thermoplastic water well casings have a long history of excellent service in the water well industry it is important to know that they are not as strong as steel casings. For any casing system there are several potential paths for water and contaminants to follow in the annulus along the casing. One path is through the grout material itself. If the best materials are improperly installed a highly permeable seal can result. The property used to measure the flow of fluid through a porous material such as a grout seal is called the coefficient of permeability. It measures the amount of fluid passing through a porous media per unit cross sectional area in a period of time when subjected to a pressure head. A direct approach to demonstrate a good seal is to pressure test the casing. (Baker-FRC)
W84-00586

CORROSION PROTECTION OF CONCRETE AND STEEL TANKS AND RESERVOIRS.
Water Services, Vol 84, No 1010, p 238, 241, April, 1980.

Descriptors: *Protective coatings, *Concrete technology, *Corrosion control, Coatings, Steel, Storage tanks, Wastewater treatment facilities, Reservoirs, Potable water, Epoxy resins.

The useful life of concrete and steel water storage tanks and reservoirs can be prolonged with effective corrosion protection. Sewage handling structures are increasingly exposed to higher temperatures and modern detergents, which increase the power of the sewage to penetrate the concrete surface. Many coatings (epoxy, chlorinated rubber, and coal tar pitch-epoxy) are available for these applications and must be specified according to conditions encountered. Best results are obtained when coatings are applied to properly cleaned surfaces, using the specific method for the material involved. Engineers should use only specialized, experienced contractors who have detailed knowledge of coatings application. It is helpful if these coating specialists are consulted during the planning stage. (Cassar-FRC)
W84-00590

8I. Fisheries Engineering

AQUACULTURE TECHNIQUES: PRELIMINARY STUDIES ON CARRYING CAPACITIES AND CENSUS-TAKING IN SERIAL REUSE PONDS,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
G. W. Klontz, C. M. Herr, and T. J. McArthur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120823, Price codes: A04 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, July 1983. 45 p, 5 Fig, 10 Tab, 18 Ref. OWRT A-075-IDA(1), 14-34-0001-2114.

Descriptors: *Oxygen consumption, *Aquaculture, *Rainbow trout, *Pond census-taking, Model studies, *Carrying capacity, Dissolved oxygen, Flow rates, Water temperature, Fish size.

A fish size and water temerature compensated model to measure the oxygen consumption of rainbow trout was developed and tested under laboratory and limited field conditions. The model is log mg/hr 0 sub 2 consumption = 0.847532 + 0.8428 log g/fish + 0.03733C. Although the model is logically and mathematically correct, several technical inaccuracies were detected when the model was applied to determine the number of rainbow trout in a raceway population. These inaccuracies were attributed to the sensitivities of the methods used to determine the dissolved oxygen concentrations and flow rates of the water entering and leaving the systems. Further studies are planned.
W84-00432

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10C. Secondary Publication And Distribution

SOURCES OF COMPUTER PROGRAMS IN HYDRAULICS.
For primary bibliographic entry see Field 7C.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 17, NUMBER 3
MARCH 1984

01 -- W84-01050
SWR ABW

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 3
MARCH 1984

W84-00701 -- W84-01050

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Information Center
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Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

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constructed wells locally may exceed
ons per minute. Recharge to the outwash
wmelt and rain ranged from 3.2 to 6.1
1979-80. Discharge from the aquifer, as
of the Pelican River averaged 2.0 inches
80. Evapotranspiration is 22.4 inches per
chemical quality of ground-water is suit-
rrigation as measured by sodium-adsorp-
s, but locally high concentrations of cal-
gnesium, and bicarbonate may cause clog-
ell screens. Mathematical models of parts
ound-water-flow system indicate that lake
streamflow may decline due to pumping
e exact water-level decline is dependent
tal number of wells, pumping rates, loca-
mping wells with respect to one another
ace-water bodies, duration of pumping,
mount of ground-water recharge. Sensi-
alyses of the models indicates that addi-
ta on hydraulic conductivity, evapotran-
and recharge may increase the reliability
results. Buried aquifers are known to be
n the area. Aquifer-test results showed
ping from a buried aquifer had no effect
levels in the unconfined aquifer. (USGS)
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**D WATER IN THE SEASIDE AREA,
RREY COUNTY, CALIFORNIA,**
al Survey, Sacramento, CA. Water Re-
Div.
ir.
e from the National Technical Information
Springfield, VA 22161 as PB83-149229,
les: A03 in paper copy, A01 in microfiche.
Vater Recharge Investigations Report 82-
mber 1982. 37 p, 10 Fig, 7 Tab, 29 Ref.

ors: *Groundwater reservoirs, *Ground-
charge, Groundwater storage, Yield, Mon-
unty, Seaside, *California.

nd-water resources in the Seaside area, in
oastal Monterrey County, is described and
. The Santa Margarita Sandstone, Paso
Formation, Aromas Sand, and the Older
with an aggregate maximum thickness of
n 1,000 feet, constitute the ground-water
. The Monterrey Shale and granitic rocks
bottom and southern boundaries of the
. Recharge to the ground-water reservoir
s infiltration of rain, subsurface inflow
jacent areas, and seepage from streams.
iltration accounts for about 75% of the
. Most of the area is classified as having a
fair recharge potential. Areas in the east
g the southern boundary of the study area
poor recharge potential. Ground water
om the eastern part of the reservoir west-
ward Monterrey Bay. The amount of
round water in storage in the Seaside area
n 1979, was estimated to be 730,000 acre-
e coastal part of the area from Monterrey
nd 1.5 miles has 9,000 acre-feet stores
ea level. The ground-water yield of the
art of the area is estimated to range from
3,000 acre-feet per year, and the yield of
l reservoir system is estimated to range
400 to 7,700 acre-feet per year. Ground
the Seaside area is chemically suitable for
es; however, dissolved-solids content and
are objectionably high for domestic use.
dissolved iron is a problem. Seawater
n poses the major threat of water-quality
tion. An observation-well network could
lished. Additional geologic and hydrologic
ion would better define the factors that
the storage and movement of ground
USGS)
991

**MINARY EVALUATION OF THE
ND-WATER-FLOW SYSTEM IN THE
CITIES METROPOLITAN AREA, MIN-
A,**
ical Survey, St. Paul, MN. Water Re-
Div.
swa, D. I. Siegel, and D. C. Gillies.
le from the National Technical Information
Springfield, VA 22161 as PB83-174599,
des: A04 in paper copy, A01 in microfiche.
USGS Water Resources Investigations Report 82-44, August 1982. 65 p, 43 Fig, 7 Tab, 19 Ref.

Descriptors: *Hydrologic model, *Hydrologic systems, Groundwater quality, Groundwater, Aquifers, Geologic units, *Minnesota, Twin Cities, *Mississippi River, Minnesota River, St. Croix River.

A preliminary quasi-three-dimensional finite-difference ground-water-flow model of the seven-county Twin Cities Metropolitan area was constructed and used to evaluate parameter sensitivity and adequacy of available data. Fourteen geologic units that underlie the study area were grouped into nine hydrogeologic units and were incorporated into a five-layer model. The layers in the simulation model include the Mount Simon-Hinckley, Ironton-Galesville, Prairie du Chien-Jordan, and St. Peter aquifers and the drift. Sensitivity analyses were made for 19 parameter and boundary-condition specifications. Model results are most sensitive to recharge and withdrawal rates and hydrogeologic variations related to drift-filled bedrock valleys. Analyses of available data and results of steady-state simulations indicate that critical data needs for improving the simulation model include (1) spatial and temporal variations in ground-water withdrawals and potentiometric levels, and (2) hydraulic properties of the drift that fills or partly fills bedrock valleys. Areal distribution of calcium, sodium, sulfate, and chloride concentrations were analyzed to provide information on the hydrologic and geochemical relationships between aquifers. Ground water is generally of the calcium magnesium bicarbonate type. Concentration of dissolved solids in the Jordan Sandstone and Mount Simon-Hinckley aquifer generally decreases from southwest to northeast across the study area. This decrease probably reflects differences in the quality of recharge water and geochemical processes within the aquifers such as ion-exchange. (USGS)
W84-00995

HYDROGEOLOGY OF A LANDFILL OPERATION, PINELLAS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-00996

GRAVITY SURVEY OF DIXIE VALLEY, WEST-CENTRAL NEVADA,
Geological Survey, Boise, ID. Water Resources Div.
D. H. Schaefer.
USGS Open-File Report 82-111, 1983. 17 p, 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Gravimetric prospecting, Geophysical prospecting, Dixie Valley, *Nevada, *Alluvial thickness, Geothermal resources.

Dixie Valley, a northeast-trending structural trough typical of valleys in the Basin and Range Province, is filled with a maximum of about 10,000 feet of alluvial and lacustrine deposits, as estimated from residual-gravity measurements obtained in this study. On the basis of gravity measurements at 300 stations on nine east-west profiles, the gravity residuals reach a maximum of 30 milligals near the south-central part of the valley. Results from a three-dimensional inversion model indicate that the central depression of the valley is offset to the west of the geographic axis. This offset is probably due to major faulting along the west side of the valley adjacent to the Stillwater Range. Comparison of depths to bedrock obtained during this study and depths obtained from a previous seismic-refraction study indicates a reasonably good correlation. A heterogeneous distribution of densities within the valley-fill deposits would account for differing depths determined by the two methods. (USGS)
W84-01000

EVALUATION OF WATER-QUALITY CHARACTERISTICS OF PART OF THE SPOKANE AQUIFER, WASHINGTON AND IDAHO, USING A SOLUTE-TRANSPORT DIGITAL MODEL,
Geological Survey, Tacoma, WA. Water Resources Div.
J. J. Vaccaro, and E. L. Bolke.
USGS Water-Resources Investigations Open-File Report 82-769, 1983. 69 p, 26 Fig, 7 Tab, 23 Ref.

Descriptors: Mathematical model, *Groundwater, *Water quality, Chlorides, *Surface/groundwater relationships, Spokane Valley, Spokane River, *Washington, *Idaho.

A digital model was developed and used to simulate solute transport of conservative ions in the Spokane aquifer. The model calculates a solute-flux budget that can be used for management purposes. The model was used specifically to estimate the impact of the chloride ion from septic-tank recharge and from land-surface-applied water on the water quality of the Spokane aquifer. Model analysis showed the estimated impact on the aquifer from these sources to be less than a 1-mg/L increase over about 80% of the aquifer, and about 3 mg/L in some peripheral locations. Other water-quality-management schemes using various man-made or natural stresses can be tested with the model. (USGS)
W84-01001

GEOTHERMAL RESOURCES OF THE WESTERN ARM OF THE BLACK ROCK DESERT, NORTHWESTERN NEVADA--PART I, GEOLOGY AND GEOPHYSICS,
Geological Survey, Boise, ID. Water Resources Div.
D. H. Schaefer, A. H. Welch, and D. K. Maurer.
USGS Open-File Report 81-918, 1983. 37 p, 15 Fig, 3 Tab, 52 Ref.

Descriptors: *Geothermal studies, Gravimetric prospecting, *Geophysical prospecting, Black Rock Desert, *Nevada.

Studies of the geothermal potential of the western arm of the Black Rock Desert in northwestern Nevada included a compilation of existing geologic data on a detailed map, a temperature survey at 1-meter depth, a thermal-scanner survey, and gravity and seismic surveys to determine basin geometry. The temperature survey showed the effects of heating at shallow depths due to rising geothermal fluids near the known hot spring areas. Lower temperatures were noted in areas of probable near-surface ground-water movement. The thermal-scanner survey verified the known geothermal areas and showed relatively high-temperature areas of standing water and ground-water discharge. The upland areas of the desert were found to be distinctly warmer than the playa area, probably due to low thermal diffusivity resulting from low moisture content. The surface geophysical surveys indicated that the maximum thickness of valley-fill deposits in the desert is about 3,200 meters. Gravity data further showed that changes in the trend of the desert axis occurred near thermal areas. (USGS)
W84-01007

AQUIFER SYSTEMS IN THE GREAT BASIN REGION OF NEVADA, UTAH, AND ADJACENT STATES--A STUDY PLAN,
Geological Survey, Boise, ID. Water Resources Div.
J. R. Harrill, A. H. Welch, D. E. Prudic, J. M. Thomas, and R. L. Carman.
USGS Open File Report 82-445, 1983. 49 p, 18 Fig, 39 Ref.

Descriptors: *Aquifer systems, *Regional analysis, Ground water, Geohydrology, Mathematical models, *Great Basin, *Regional aquifer system, *Nevada, *Utah.

The Great Basin Regional Aquifer Study includes about 140,000 square miles in parts of Nevada, Utah, California, Idaho, Oregon, and Arizona within which 240 hydrographic areas occupy structural depressions formed primarily by basin-and-range faulting. The principal aquifers are in basin-fill deposits; however, significant carbonate-rock aquifers underlie much of eastern Nevada and western Utah. In October 1980, the U.S. Geologi-

cal Survey started a 4-year study to: (1) describe the ground-water systems, (2) analyze the changes that have led to the systems' present conditions, (3) tie the results of this and previous studies together in a regional analysis, and (4) provide means by which effects of future ground-water development can be estimated. A plan of work is presented that describes the general approach to be taken. It defines the major tasks necessary to meet objectives and defines constraints on the scope of work. The approach has been influenced by the diverse nature of ground water flow systems and the large number of basins. A detailed appraisal of 240 individual areas would require more resources than are available. Consequently, the general approach is to study selected 'typical' areas and key hydrologic processes. Effort during the first three years will be directed toward describing the regional hydrology, conducting detailed studies of 'type' areas and studying selected hydrologic processes. Effort during the final year will be directed toward developing a regional analysis of results. Special studies will include evaluation of regional geochemistry, regional hydrogeology, recharge, ground-water discharge, and use of remote sensing. Areas to be studied using ground-water flow models include the regional carbonate-rock province in eastern Nevada and western Utah, six valleys--Las Vegas, Carson, Paradise, Dixie, Smith Creek, and Stagecoach--Nevada, plus Jordan Valley, the Millford area, and Tule Valley in Utah. The results will be presented in a series of reports that will summarize findings, hydrologic principles, and techniques that can be applied throughout the Great Basin. (USGS)
W84-01008

HYDROGEOLOGY AND SIMULATION MODEL OF WATER FLOW IN THE KOOTENAI AQUIFER OF THE JUDITH BASIN, CENTRAL MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
J. F. Levings.
USGS Water-Resources Investigations, Report 83-4146, September 1983. 39 p, 15 Fig, 35 Ref.

Descriptors: *Model studies, Computer models, *Groundwater, *Geohydrology, Structural geology, Judith basin, Fergus County, Judith Basin County, *Montana.

Five Jurassic and Cretaceous formations in the Judith basin of central Montana were investigated with a three-dimensional model to improve the understanding of water flow in the Kootenai aquifer. To accomplish this objective, of water flow in the aquifers and two intervening confining layers was constructed from existing data. A steady-state model was calibrated and evaluated using a parameter-estimation procedure. The digital model simulates horizontal flow in the middle (Kootenai) aquifer and vertical leakage through the overlying and underlying confining layers. The top and bottom aquifers are used as constant-head boundaries to aid in simulating vertical leakage. Transmissivity for the aquifer obtained from the calibrated model ranges from 137 to 364 ft super 2/d. Recharge in the form of precipitation on the outcrop is about 2% of total precipitation (5.44 ft super 3/s). The other component of net recharge is 32.48 ft super 3/s of vertical leakage from the Swift aquifer. The cumulative rate of discharge from all known wells completed in the aquifer is about 0.84 ft super 3/s. Other components of net discharge are 1.83 ft super 3/s of underflow and 35.25 ft super 3/s of vertical leakage to the Colorado aquifers. Estimates of vertical hydraulic conductivity are 2.15 x 10- super 2 ft/d for the lower confining layer, and 3.16 x 10- super 3 and 1.33 x 10- super 4 ft/d for the upper confining layer. (USGS)
W84-01009

GEOHYDROLOGY OF THE FRESH-WATER AQUIFER SYSTEM IN THE VICINITY OF OCEAN CITY, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
J. M. Weigle, and G. Aehmad.
Maryland Geological Survey, Baltimore, Report of Investigations No 37, 1982. 55 p, 29 Fig, 7 Tab, 29 Ref.

Descriptors: *Groundwater movement, *Confined groundwater, *Computer models, Hydrogeology, Aquifers, Groundwater recharge, Groundwater discharge, Potentiometric level, Hydraulic conductivity, Model studies, Saline water, Saline-water intrusion, Sea water, *Inter-aquifer leakage, Cone of depression, Groundwater flow model, Multilayer aquifer model, Quasi three-dimensional model, *Model simulations, Chloride concentration, Vertical leakage, Groundwater withdrawal, Hydraulic stress, Cyclic water-level changes.

Fresh ground water in northeastern Worcester County is restricted to the upper 450 feet of Coastal Plain sediments. Water is available in the Pleistocene water-table aquifer and the Pocomoke, Ocean City, and Manokin artesian aquifers. The sediments, water table, and potentiometric surfaces slope generally east-southeastward. The hydrogeologic structure in the study area continues offshore for at least several miles. Recharge from precipitation in the western part of the area affects all the freshwater aquifers. Under nonpumping conditions, discharge occurs primarily by upward leakage in the eastern part of the area and offshore. Lateral ground-water movement is east-south-eastward. Salty water occurs in the ocean and back bays near Ocean City, and possibly offshore in the Manokin aquifer. Also, at Ocean City some salty water has apparently leaked upward into the basal part of the Manokin aquifer from the underlying St. Marys Formation. Water needs for Ocean City and the nearby mainland are expected to substantially increase and most of this water will probably be withdrawn from the freshwater aquifers underlying the area. Simulation of alternate groundwater development plans with an uncalibrated model indicates that dispersal of pumping centers may spread drawdown cones and may reduce the magnitudes of drawdowns. (USGS)
W84-01011

WATER RESOURCES OF THE SANTA FE RIVER BASIN, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. D. Hunn, and L. D. Slack.
USGS Water-Resources Investigations Report 83-4075, 1983. 105 p, 30 Fig, 9 Tab, 41 Ref.

Descriptors: *Groundwater resources, *Aquifers, *Aquicludes, *Streamflow, *Water quality, Surface-ground-water relationships, Lakes, Springs, Groundwater recharge, Karst, Dissolved solids, Hardness, Sulfates, Low flow, *Santa Fe River Basin, Suwannee basin, *Florida, Floridan aquifer, Surficial aquifer.

The Santa Fe River basin is a 1,384 square-mile area in north-central Florida. The principal source of water is the Floridan aquifer, a sequence of limestone beds, the upper 300 to 800 feet of which contain potable water. The western part of the basin has the greatest potential yields for individual wells, as much as 5,000 gallons per minute, and contains the largest surface-water supplies. Spring discharge and diffuse seepage from the Floridan aquifer augment the Santa Fe River. The Floridan aquifer is overlain by a confining bed that in the western part of the basin is ineffectual. In the eastern part the Floridan aquifer is confined and the confining bed is overlain by a surficial aquifer. The confining bed contains water-yielding zones, which in addition to the surficial aquifer, may supply water for domestic use. Numerous tributary streams supply small amounts of water to the Santa Fe River and its principal tributary, New River. The base flow of most of these streams is supplied by the surficial aquifer. Estimated water use is about 17 million gallons per day, and runoff from the basin is estimated to be 1,400 million gallons per day. (USGS)
W84-01013

IMPACT OF CHANGES IN LAND USE ON THE GROUND-WATER SYSTEM IN THE SEQUIM-DUNGENESS PENINSULA, CLALLAM COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water
sources Div.
For primary bibliographic entry see Field 4C.
W84-01014

ASSESSMENT OF THE INTERCONNECT BETWEEN TAMPA BAY AND THE FL DAN AQUIFER, FLORIDA,
Geological Survey, Tallahassee, FL. Water
sources Div.
C. B. Hutchinson.
Available from National Technical Inform Service, Springfield, VA 22161 as ADA-13(Price codes: A04 in paper copy, A01 in microfi USGS Water-Resources Investigations Repor 54, 1983. 55 p, 23 Fig, 5 Tab, 58 Ref.

Descriptors: *Saline water intrusion, *Comp models, Groundwater movement, Hydrogeol Dredging, Water management(Applied), Leak Floridian aquifer, Tampa Bay, *Florida.

Factors that control interflow between Tampa and the Floridan aquifer are assessed, both qua tively and quantitatively, with emphasis on impact of harbor improvement. Hydrogeol units underlying the 350-square-mile bay incl the surficial-sand aquifer, upper sand and clay fining bed, and limestone of the Floridan aqu The surficial aquifer and upper confining bed h been eroded away in several areas along the no ern coast of the bay to directly expose the Flori aquifer to saltwater. There also, the top of aquifer is, has been, or will be exposed to saltw in numerous channels dredged in the Saltwater-freshwater relations indicate that degree of bay-aquifer interconnection decre from north to south. Saltwater intrusion is oc ring along the coast of Tampa Bay, as indicated reduction or reversal of potentiometric-surf gradients and increasing chloride concentration coastal monitoring wells. A computer model ground-water flow developed for a 97-square-m area was interrogated under five options of ch nelization and pumping. Model results indicate the total impact of channelization upon bay-aqu interconnection are expected to be small and m be imperceptible when considered over the l term with other unknown changes in climate development. (USGS)
W84-01019

EVALUATION OF THE HYDROLOG SYSTEM IN THE NEW LEIPZIG COAL AR GRANT AND HETTINGER COUNTI NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water
sources Div.
C. A. Armstrong.
Available from the OFSS, USGS, Lakewood C 80225, Price: $6.75 in paper copy, $5.00 in mic fiche. USGS Open-File Report 82-698, Aug 1982. 41 p, 16 Fig, 4 Tab, 11 Ref.

Descriptors: *Hydrologic system, *Groundwat *Aquifers, Transmissivity recharge, Chemi properties, Potential yield, Grant County, H tinger County, *North Dakota.

Aquifers in the New Leipzig coal area consist sandstone beds in the Fox Hills Sandstone, the H Creek Formation, the Cannonball and Ludlo Members of the Fort Union Formation, and t basal part of the Tongue River Member of t Fort Union Formation. Aquifers also occur sandstone and lignite beds in the upper part of t Tongue River Member and Sentinel Butte Memb of the Fort Union Formation. Potential well yiel from each of the aquifers are variable, but are le than 100 gallons per minute. Water in the F Hills, Hell Creek, Cannonball, and Ludlow is so and of the sodium bicarbonate type. Water in bas Tongue River aquifer is either soft or very ha and generally is of the sodium bicarbonate typ Water in the upper Tongue River and Sentin Butte aquifer system is very hard and generally either of the calcium bicarbonate or sodium bica bonate type. There is little or no contribution ground water to Thirty Mile Creek or the Canno ball River from the area of minable coal. Co mining will expose sulfide minerals to oxidatio

sult in an increase in dissolved solids and in water in the basal Tongue River aquifer.
)
1022

OLOGY OF THE BERYL-ENTERPRISE ESCALANTE DESERT, UTAH, WITH ASIS ON GROUND WATER,
gical Survey, Salt Lake City, UT. Water ces Div.
Mower.
Department of Natural Resources, Salt Lake Technical Publication No 73, 1982, 66 p, 32 Tab, 42 Ref.

ptors: *Groundwater recharge, *Ground- discharge, *Groundwater mining, Under- Evapotranspiration, Groundwater models, Enterprise area, *Utah, Escalante Desert, unty, Washington County.

Beryl-Enterprise area encompasses 1,920 miles in southwestern Utah. Water used in a is supplied by three small streams and a of wells that tap valley fill. The 1959-78 annual reported diversions from the was 6,500 acre-feet. Withdrawals by wells gation increased from 3,000 acre-feet in 1937 00 acre-feet in 1974, the maximum ever ed. In 1977, recharge to the principal -water reservoir was an estimated 48,000 et, but discharge was an estimated 88,000 et. By 1977, withdrawals had so greatly ed recharge that a large depression had on the water table in the southern half of ervoir. In 1978, the ground-water reservoir ed about 72 million acre-feet of water in . An analysis by digital-computer model that with the 1969-77 pumpage and water- imen continuing, water levels will continue ne to 1992 at a slightly lower rate than they ing 1969-77. (USGS)
1024

R RESOURCES OF MANATEE COUNTY DA,
gical Survey, Tallahassee, FL. Water Re- Div.
Brown.
ble from the National Technical Information , Springfield, VA 22161 as PB83-218396, odes: A06 in paper copy, A01 in microfiche. Water Resources Investigations Report 81- 3. 112 p, 38 Fig, 19 Tab, 87 Ref.

ptors: *Surface water resources, *Ground- resources, *Water quality, Water utilization, rk design, Aquifers, Manatee County, da, Floridan aquifer.

development of Manatee County in south- lorida is creating water-resource problems. eport presents an evaluation of the water es and potential effects of water-resource pments. Most streams in the county have drainage basins and minimal flow. Stream- variable with the base flow occurring from ber to May. The Manattee River and its tributary, the Braden River, are the princi- urces of public supplies. Surface water is lly of good quality and less mineralized than water except in the tidally affected and area. The principal aquifers in the county surficial, minor artesian, and the Floridan. oridan aquifer is the major source of irriga- ater in the county. The minor artesian is a highly developed source of water for ural supplies. Withdrawals of 20 to 50 mil- llons per fay from the Floridan aquifer since 50's have caused declines in the potentiome- rface of about 20 to 50 feet. The quality of water is good except in the coastal and rn parts of the county. Water in the Floridan is generally more mineralized than the quifers, generally increasing in mineral con- th depth and from the northeast towards the est. (USGS)
1026

OGEOLOGY OF THE PROVIDENCE FER OF SOUTHWEST GEORGIA,
Geological Survey, Doraville, GA. Water Resources Div.
J. S. Clarke, E. Faye, and R. Brooks.
Georgia Department of Natural Resources, Atlanta, Hydrologic Atlas No 11, 1983. 49 p, 16 Fig, 5 Tab, 25 Ref.

Descriptors: *Georgia, *Hydrogeology, Subsurface mapping, Groundwater, *Aquifer characteristics, *Potentiometric level, Groundwater, *Aquifer characteristics, *Potentiometric level, Groundwater recharge, Leakage, Groundwater movement, Groundwater divide, Water-level fluctuations, Chemical analysis, Water use, Well drilling, Upper cretaceous, Lower tertiary, Chattahoochee River, Flint River, Ocmulgee River, Providence Aquifer.

The predominantly sand Providence aquifer lies within the Coastal Plain physiographic province of southwest Georgia and ranges in thickness from 38 to 386 feet. Estimated transmissivities range from 760 feet squared per day in Schley County to 4,600 feet squared per day in Clay County. Recharge water enters the aquifer in the eastward trending outcrop belt and flow southward, bounded by the Ocmulgee River on the east and the Chattahoochee River on the west. Additional recharge is received through leakage from underlying units. Ground water is discharged from the aquifer to streams both in the outcrop area and downdip through overlying units. Idle multiaquifer wells in Albany and Dawson provide conduits for upward discharge of water from the Providence aquifer. (USGS)
W84-01031

EFFECTS OF GROUND-WATER DEVELOPMENT IN THE NORTH FORT HOOD AREA, CORYELL COUNTY, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
W. M. Sandeen.
USGS Water-Resourses Investigations Report 83-4074, 1983. 49 p, 5 Fig, 8 Tab, 9 Ref.

Descriptors: *Groundwater, *Texas, Fort Hood, Coryell County, *Groundwater withdrawals, *Water-level declines, Slightly saline water.

Nearly all ground water in the North Fort Hood area, located in Coryell County in central Texas, is withdrawn from the Hensell and Hosston Members of the Travis Peak Formation. The total average annual rates of ground-water withdrawals, mostly for public supply, has steadily increased from nearly 0.5 million gallons per day during 1955 to more than 1.5 million gallons per day during 1980. The principal effect of the long-term development of ground water in the area has been a large decline of water levels in wells. The historical confined (artesian) conditions of the principal aquifer have changed to water-table conditions in some areas as the artesian head drops below the base of the confining layer due to pumping. The greater storage property of the unconfined system will decrease the rate of water-level declines. However, well yields will continue to decrease in relation to the general decline of hydraulic head in the aquifer. The ground water in the area is slightly saline with the concentrations of some constituents generally exceeding chemical-quality limits set by the U.S. Environmental Protection Agency for public-water supplies. The historical chemical changes in the ground water generally are insignificant and appear unrelated to the large declines of water levels of the area. (USGS)
W84-01032

RESULTS OF HYDRAULIC TESTS IN U.S. DEPARTMENT OF ENERGY'S WELLS DOE-4, 5, 6, 7, 8 AND 9, SALT VALLEY, GRAND COUNTY, UTAH,
Geological Survey, Denver, CO. Water Resources Div.
L. E. Wollitz, W. Thordarson, M. S. Whitfield, Jr., and J. E. Weir, Jr.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $10.00 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-346, 1982. 71 p, 33 Fig, 15 Tab, 19 Ref.

Descriptors: *Aquifer tests, *Hydraulic conductivity, *Transmissivity, Drawdown curves, Recovery curves, Saline groundwater, Salts, Radioactive dating, *Utah, Water wells, Paradox Member, Hermosa Formation, *Salt Valley Anticline, Paradox basin, Grand County.

Six exploratory wells, were drilled into the cap rock underlying Salt Valley, Utah, for geologic, geophysical, and hydrologic data to augment information obtained from three previous test wells. Drilling of three other test holes was abandoned before reaching the zone of saturation; the upper 100 meters of cap rock is unsaturated. Within the saturated part of the cap rock, hydraulic heads generally decrease with depth and to the northwest in this part of the valley. Hydraulic conductivity of the cap rock, as determined from pumping tests, ranged from 0.000093 to 0.206 meters per day; as a result, natural ground-water flow rates in the cap rock are small. Water ranges from a calcium bicarbonate sulfate type on the western edge of the valley to a calcium magnesium sodium bicarbonate, sulfate, chloride type near the center of the valley. Carbon-14 specific activity for cap-rock water yielded an uncorrected age of about 17,000 to 26,000 years before present near the western edge of the valley and about 1,000 years before present near the center of the valley. (USGS)
W84-01039

GROUND-WATER RESOURCES OF RANSOM AND SARGENT COUNTIES, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
C. A. Armstrong.
North Dakota Geological Survey, Bismarck, Bulletin 69, 1982. 51 p, 14 Fig, 3 Tab, 48 Ref.

Descriptors: *Water resources, *Ground water, *Aquifers, Transmissivity, Recharge, Water use, Chemical properties, Potential yield, Ransom County, Sargent County, *North Dakota.

Ground water in Ransom and Sargent Counties is available from the Dakota aquifer system of Cretaceous age and from aquifers in the glacial drift and alluvial aquifers Quaternary age. The Dakota aquifer system has a greater areal extent, but aquifers in the glacial drift provide a greater yield to individual wells. The Dakota aquifer system generally yields less tha 50 gallons per minute to wells. The water ranges from soft to very hard and is a sodium sulfate or sodium chloride type. Glacial-drift aquifers consist of sand and gravel deposits in buried valleys and glacioaqueous deposits in Ransom and Sargent Counties. These aquifers underlie about 690 square miles and contain an estimated 3,000,000 acre-feet of available ground water. Potential well yields range from 50 to 1,500 gallons per minute. The water generally is hard and is a calcium or sodium bicarbonate type. The rural population and all communities in Ransom and Sargent Counties depend on ground water as their source of supply. (USGS)
W84-01050

2G. Water In Soils

MATHEMATICAL MODELS OF SOIL MOISTURE PROFILES USING TWO-PHASE FLOW THEORY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140599, Price codes: A04 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 127, Colorado State Univ., Fort Collins, July 1983. 58 p, 3 Fig, 1 Tab, 5 Ref. OWRT B-207-COLO(1), 14-34-0001-0260.

Descriptors: *Model studies, *Mathematical studies, *Finite difference methods, *Soil water, *Infiltration, *Soil moisture profiles, Two-phase flow theory.

Three methods of analysis for prediction of infiltration and water content profiles in a soil column are

presented. The first method is the more or less classical finite difference approach except that the governing equations are those deduced from two-phase flow theory. As a result the determination of the water content at the soil surface before ponding is facilitated. Similarly, after ponding the calculation of the capacity infiltration rate is more stable than with the usual finite difference approximations to Richard's equation. The second method is purely analytical. It 'speaks' as results such as ponding time are obtained explicitly in terms of the various parameters of the problem (hydraulic conductivity, effective capillary drive, initial water content, etc.). Each solution applies for a particular value of the exponent n in the power law form of the relative permeability vs. normalized water content curve. Solutions have been obtained for n = 1,2,3,4,6 and 8. Profiles look realistic. Nevertheless, the results are approximate. A third method, a hybrid method, tries to combine the advantages of the numerical and analytical techniques by retaining the versatility of the numerical method and the low cost of the analytical method. The hybrid method is illustrated in depth for the case n = 1. The case n = 2 has been discussed previously in the literature (Morel-Seytoux, 1982). Results for the case n = 4 are given without derivation. The case n = 4 has been implemented operationally in a computer program SOILMOP. Tests (though limited) indicate that accuracy with SOILMOP is comparable with existing difference code for the Richar's equation and is 25 times cheaper. The hybrid technique appears to have a significant potential.
W84-00966

HYDRAULIC CONSIDERATIONS IN SAMPLING THE UNSATURATED ZONE WITH INCLINED GRAVITY LYSIMETERS,
Geological Survey, Albany, NY. Water Resources Div.
E. T. Oaksford.
USGS Water-Resources Investigations Report 83-4005, 1983. 17 p, 12 Fig, 9 Ref.

Descriptors: *Gravity lysimeters, *Water sampling, *Unsaturated zone, *Soil water, Suffolk County, Long Island, *New York.

Inclined gravity lysimeters as deep as 5.39 meters below land surface designed for sampling soil water in coarse sand under continuous ponding conditions, were shown to be capable of collecting 10 liters per hour at an infiltration rate of 0.5 meter per hour. This represents a capture efficiency of approximately 50%, a value observed in two similar but shallower lysimeters. When lysimeters are installed from a trench or observation manhole, soil-water samples can be taken under virtually undisturbed conditions, avoiding the soil disturbance and filtration associated with porous-cup vacuum lysimeters. Successful operation requires that the sampler be designed for the hydraulic characteristics of the soil from which the water sample is to be extracted. Criteria for lysimeter dimensions can be established on the basis of pressure heads experienced during sampling, can be induced to flow into the lysimeter by gradient manipulation. Observed head gradients outside the lysimeter ranged between 1.7 and 2.2 times those across the lysimeter, which would seem to explain the observed capture efficiency. (USGS)
W84-01018

2H. Lakes

LIMNOLOGICAL CHARACTERISTICS OF WISCONSIN LAKES,
Wisconsin Dept. of Natural Resources, Madison.
R. A. Lillie, and J. W. Mason.
Technical Bulletin No 138, 1983. 116 p, 84 Fig, 43 Tab, 184 Ref, 2 Append.

Descriptors: *Lakes, *Limnology, *Lake morphometry, *Chemical analysis, *Trophic level, *Water quality, Water sampling, Thermal stratification, Chlorophyll A, Macrophytes, Alkalinity, Phosphorus, Nutrients, Secchi disks, Chlorides, Cations, Sulfates, Nitrogen, Water quality management, *Wisconsin.

A 14-year study of Wisconsin lakes began in 1966 when the Wisconsin Legislature recognized the need for data on the state's water resources. This report is intended as a technical reference for professionals in water-related fields. A random selection of 1,140, or 25% of Wisconsin lakes, all greater than 5 feet deep and 25 acres in size, comprised the data base. Water samples were collected and subjected to physical, chemical and biological analyses. These results, with field notes and known morphometric characteristics, formed the core of the data used in the study. The data allowed the evaluation and examination of general limnological characteristics of Wisconsin lakes. An apparent water quality index is presented for Wisconsin lakes, incorporating water clarity, chlorophyll concentration, and total phosphorus. Preferably, all three parameters should be used in evaluating a lake. Strong relationships exist between a great number of measured physical, chemical, and biological parameters. On the other hand, a considerable amount of scatter occurs in plots of the various interrelationships, which suggests that caution must be used in applying linear regression formulae derived from these associations for predictive purposes. Assessment of trends in water quality is restricted by insufficient data. The substantial amount of individual lake data collected and analyzed should be useful as a historical data base for evaluating future trends in water quality for sampled lakes. (Fazio-Omniplan)
W84-00794

COMPUTER SIMULATION OF PHOSPHORUS CYCLING IN THE SEDIMENT-WATER SYSTEM OF EUTROPHIC LAKES,
Maine Univ. at Orono. Dept. of Mathematics.
T. A. Hannula, and C. A. Rock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140573, Price codes: A08 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, August 1983. 156 p, 38 Fig, 8 Tab, 19 Ref, 1 Append. OWRT B-021-ME(1), 14-34-0001-1231.

Descriptors: *Computer models, *Cycling nutrients, *Diagenesis, *Lake sediments, *Phosphorus, Adsorption, Anaerobic conditions, Boundary conditions, Decomposing organic matter, Diffusion coefficient, Eutrophic lakes, Interstitial water, Mathematical models, Porosity, Radioactive dating, Recycling, Seasonal Variation, Vertical Distribution, *Maine, Lake Sebasticook.

It has become increasingly evident that the release of phosphorus from the sediments of eutrophic lakes is a major factor in the excessive productivity of these lakes. Using the diagenic partial differential equations which model the sediment processes of lakes and oceans, a computer simulation model has been developed to study the P dynamics in lake sediments. The model allows both time and depth variation of the key equation parameters. The model clearly shows that the upper 10 cm of sediment is the main region of activity. The lowering of the sorption coefficient and PIW increase are the most significant factors in a large summer P release from the sediment. The rapid burial and decomposition of organic matter in the top few centimeters of sediment in these productive lakes is sufficient to maintain the pore water and sorbed P at levels needed to support a large summer P release. The model generates summary tables and 3D plots of key variables over a year's simulation. The Numerical Method of Lines is used to solve the model equations. Data from L. Sebasticook, Newport, Maine are used to test the model.
W84-00964

HYDROLOGY OF WISCONSIN, WETLANDS,
Geological Survey, Albany, NY. Water Resources Div.
R. P. Novitzki.
University of Wisconsin-Extension, Madison, Geological and Natural History Survey, Information Circular No 40, 1982. 22 p, 14 Fig, 7 Tab, 34 Ref.

Descriptors: *Wetlands, Floods, Base flow, Sediment yield, *Wisconsin wetlands, *Hydrologic wetlands classification.

The hydrologic characteristics of Wisconsin's w
lands, and their effect on floodflows and b
flows, are described. Wetlands occur in depres
and on slopes, and may be in contact with gro
water or totally surface-water supported. Wisc
sin's wetlands can be classified as surface-w
depression, ground-water depression, surfa
water slope, or ground-water slope. Through
the State, floodflows are 80% lower, springti
streamflows 40% higher, and fall base flows 4
lower in basin with 40% lake and wetland a
than in basins with no lake and wetland area. In
north-central third of the State sediment yields
90% lower in basins with 40% lake and wetl
area. (USGS)
W84-00998

**GENERAL HYDROLOGY AND EXTERN
SOURCES OF NUTRIENTS AFFECTING PI
LAKE, KING COUNTY, WASHINGTON,**
Geological Survey, Tacoma, WA. Water
sources Div.
N. P. Dion, S. S. Sumioka, and T. C. Winter.
USGS Water-Resources Investigations Report
4057, 1983. 29 p, 10 Fig, 3 Tab, 25 Ref.

Descriptors: *Lakes, *Hydrologic budget, *Nut
ents, *Water pollution sources, *Washington, Ki
County, Pine Lake, Lake restoration.

An adjusted water budget prepared for Pine La
a candidate for lake-quality restoration, indica
that of approximately 790 acre-feet of water th
enters the lake in a typical year, 410 acre-feet
from precipitation, 350 acre-feet is from surfa
inflow, and 30 acre-feet is from ground-water see
age. A nearly equal amount of water leaves t
lake and of this, 130 acre-feet is by evaporatio
659 acre-feet is by surface runoff, and less than o
acre-foot is by ground-water seepage. Based
these amounts of inflow and outflow, the theore
cal water-renewal time of the lake is calculated
be 2.2 years. The contributions of inorganic nitr
gen and phosphorus to the lake in a typical ye
from precipitation, surface inflow, and groun
water inflow is about 2,500 pounds of nitrogen a
49 pounds of phosphorus. (USGS)
W84-01015

**WATER-QUALITY ASSESSMENT OF FRA
CIS E. WALTER RESERVOIR, LUZERNE AN
CARBON COUNTIES, PENNSYLVANIA,**
Geological Survey, Harrisburg, PA. Water R
sources Div.
J. L. Barker.
USGS Water-Resources Investigations Report 8
4032, June 1983. 51 p, 14 Fig, 17 Tab, 24 Re

Descriptors: *Water quality, *Limnology, *Nutr
ents, Physical properties, Biological properties
Chemical properties, Stratification, Luzer
County, Carbon County, Data collection, Franc
E. Walter Reservoir, *Pennsylvania.

Water-quality data, both past and present, sho
that the waters of the upper Lehigh River basin a
somewhat acidic, but otherwise are generally
good quality. This report is a summary of a
known water-quality data collected by the U.S
Geological Survey and other agencies, includes
synopsis of current water-quality conditions in th
reservoir and its tributaries. Data collected fro
June 1981 to May 1982 indicate that raising th
pool an additional 92 feet had some significant,
only temporary, detrimental effects on the rese
voir system. Depth profile measurements sho
that the dissolved oxygen concentrations were de
pressed to near-aquifer levels, and the median p
values were depressed from 6.5 to 6.0. (USGS
W84-01029

2I. Water In Plants

**WETLAND HYDROLOGY AND TREE DISTRI
BUTION OF THE APALACHICOLA RIVER
FLOOD PLAIN, FLORIDA,**
Geological Survey, Tallahassee, FL. Water Re
sources Div.
H. M. Leitman, J. E. Sohm, and M. A. Franklin.

from the Eastern Distribution Br. 04 S. Pickett St. Alexandria, VA 22304. ater-Supply Paper 2196-A, 1983. 52 p, 39 ab, 70 Ref.

rs: *Wetlands, *Trees, *Distribution pat- lood plains, Soil water, Forests, Hard- ver basins, Flood stages, Flow duration, urface water, Water level, *Florida, Apa- River.

achicola River is part of a 50,800-square- drainage basin in northwest Florida, Ala- d Georgia. The river is formed by the e of the Chattahoochee and Flint Rivers oodruff Dam and flows 171 kilometers to ola Bay in the Gulf of Mexico. Its flood ports 450 square kilometers of bottom- lwoods and tupelo-cypress forests. The mon trees, constituting 62% of the total , were five wet-site species; water tupelo, tupelo, baldcypress, Carolina ash, and pelo. Other common species were sweet- rcup oak, planertree, green ash, water sugarberry, and diamond-leaf oak. Five es were defined based on species pre- e by basal area. Biomass increased down- nd was greatest in forests growing on tly saturated soils. Water and tree rela- ed with river location because range in el fluctuation and topographic relief in plain diminshed downstream. Heights of verbank levees and size and distribution in levees had a major controlling effect plain hydrology. Depth of water, dura- undation and saturation, and river loca- not velocity, were very highly correlated cast types. (USGS)
3

osion and Sedimentation

IFLOW AND SUSPENDED-SEDI- TRANSPORT IN GARVIN BROOK, A COUNTY, SOUTHEASTERN MIN- HYDROLOGIC DATA FOR 1982,
al Survey, St. Paul, MN. Water Re- iv.
nc.
en-File Report 83-212, March 1983. 22 p, ab, 6 Ref.

rs: *Sediment discharge, *Sediment load, ow, *Particle size, Small watersheds, ration watersheds, Soil conservation, ta, Winona County.

w and suspended-sediment-transport data lected in Garvin Brood watershed in County, Southeastern Minnesota, during e data collection was part of a study to the effectiveness of agricultural best- ent practices designed to improve rural ality. The study is part of a Rural Clean ogram demonstration project undertaken S. Department of Agriculture. Continu- nflow data were collected at three gaging luring March through September 1982. d-sediment samples were collected at two aging stations. Samples were collected at weekly intervals. During periods of hanging stage, samples were collected at to 12-hour intervals by stage-activated samplers. The samplers were analyzed nded-sediment concentration and particle- ibution. Particle-size distributions were rmined for one set of bed-material samples at each sediment-sampling site. The w and suspended-sediment-concentration e used to computer records of mean-daily an-daily suspended-sediment concentra- daily suspended-sediment discharge. The ords are documented and results of analy- particle-size distribution and of vertical in the stream cross sections are given.

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IN 12, LOWER JUNIATA RIVER.
ania Dept. of Environmental Resources, rg. Office of Resources Management.

For primary bibliographic entry see Field 6D.
W84-00842

STREAMFLOW AND SEDIMENT TRANSPORT IN THE QUILLAYUTE RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
L. M. Nelson.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $4.25 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-627, 1982. 29 p, 11 Fig, 7 Tab, 19 Ref.

Descriptors: *Sediment, Sediment transport, *Sediment yield, Bedloads, *Low flows, Streamflows, Land use, Jefferson County, Clallam County, Quillayute River, *Washington.

From October 1976 to September 1978 the U.S. Geological Survey made a reconnaissance evaluation of the fluvial-sediment transport and documented the natural streamflow characteristics in the Quillayute River basin in northwestern Washington. Most of the flow originates from the tributaries, the Soleduck, Bogachiel, and Calawah Rivers. Flow in the summer months from the Calawah River is about half that from either the Bogachiel or Soleduck Rivers. In the winter months flow from the Soleduck River is about 1 1/2 times that of the Bogachiel or Calawah Rivers. In general, the highest monthly flows during the winter are about 10 times greater than the lowest monthly flows during the summer except for the Dickey River where winter flows are about 20 times greater. Annual mean discharges may vary greatly from year to year, ranging from about 1/2 to 1 1/2 times the mean annual discharge. For the study period, the observed suspended-sediment concentration ranged from less than 1 to 2,150 milligrams per liter. The estimated mean annual suspended-sediment discharges were: Bogachiel River--400,000 tons (includes Calawah River); Calawah River--120,000 tons; Soleduck River--120,000 tons; Dickey River--75,000 tons; and other tributaries--10,000 tons, for a total of 606,000 tons transported annually by the Quillayute River. The estimated annual bedload of 21,000 tons was transported into the Quillayute River by the Soleduck, Bogachiel, and Dickey Rivers. (USGS)
W84-00920

FIELD DATA DESCRIBING THE MOVEMENT AND STORAGE OF SEDIMENT IN THE EAST FORK RIVER, WYOMING: PART III. RIVER HYDRAULICS AND SEDIMENT TRANSPORT, 1980,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00937

AN EVALUATION OF SUSPENDED SEDIMENT AND TURBIDITY IN COW CREEK, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
D. A. Curtiss.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $3.25 in paper copy, $3.50 in microfiche. USGS Water Resources Investigations Open-File Report 82-364, 1982. 21 p, 11 Fig, 4 Tab, 9 Ref.

Descriptors: *Sediments, *Sediment transport, *Turbidity, Fluvial sediments, Sediment distribution, Settling velocity, *Residual turbidity, *Clay transport, *Oregon, Douglas County, Cow Creek.

During a 6-month period from December 1980 through May 1981, samples were collected from Cow Creek near Azalea, Oregon, and analyzed for suspended sediment, particle-size distribution, and turbidity. Of the estimated suspended-sediment discharge of 4,270 tons for the 1981 water year, 95% (4,050 tons) was transported during a major storm event December 2-4, 1980. The 1981 water year suspended-sediment discharge of 4,270 tons is well below the average annual suspended-sediment discharge of 22,000 tons reported earlier by Curtiss. A clay-sediment transport curve was used in conjunction with the flow-duration curve to estimate average annual clay discharge of 3,700 tons for Cow Creek near Azalea. Turbidity in Cow Creek near Azalea is estimated to be equal to or less than 15 NTU (nephelometric turbidity units) 90% of the time. A method for predicting turbidity values in a hypothetical impoundment is presented in this report. This method utilizes a suspended-sediment transport curve of the fine material (<0.002 mm) and measure residual-turbidity values. (USGS)
W84-00939

MINERALOGY OF FINE-GRAINED ALLUVIUM FROM BOREHOLE U11G, EXPL. 1, NORTHERN FRENCHMAN FLAT AREA, NEVADA TEST SITE,
Geological Survey, Reston, VA. Water Resources Div.
B. F. Jones.
USGS Open-File Report 82-765, 1982. 10 p, 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Mineralogy, *Clays, *Zeolites, *Alluvium, Water table, Hydration reactions, Weathering, Volcanic glass, Chemical analyses, *Nevada, Frenchman Flat, Smectite, Sepiolite, Interstratified minerals.

The mineralogy of matrix fines in alluvium from borehole Ullg, expl. 1, north of Frenchman Flat, Nevada Test Site, has been examined for evidence of past variations in water table elevation. Although greater abundance of zeolite and slightly more expanded basal spacings in smectite clays suggest effects of increased hydration of material up to 50 m above the present water table, these differences might also be related to provenance of environment of deposition. The relative uniformity of clay hydration properties in the 50 meters above the current water table suggest long-term stability near the present level. (USGS)
W84-00946

MICROCOMPUTER COMPUTATION OF WATER QUALITY DISCHARGES,
Geological Survey, Columbus, OH. Water Resources Div.
D. R. Helsel.
USGS Open-File Report 82-901, 1983. 48 p, 7 Fig, 2 Tab, 2 Ref.

Descriptors: *Computer programs, *Water quality, *Sediment discharge, Hydrographs, Suspended land.

A fully prompted program (SEDQ) has been developed to calculate daily and instantaneous water quality (QW) discharges. It is written in a version of BASIC, and requires inputs of gage heights, discharge rating curve, shifts, and water quality concentration information. Concentration plots may be modified interactively using the display screen. Semi-logarithmic plots of concentration and water quality discharge are output to the display screen, and optionally to plotters. A summary table of data is also output. SEDQ could be a model program for micro and minicomputer systems likely to be in use within the Water Resources Division, USGS, in the near future. The daily discharge-weighted mean concentration is one output from SEDQ. It is defined in this report, differentiated from the currently used mean concentration, and designated the 'equivalent concentration.' (USGS)
W84-00985

SEDIMENT AND STREAM-VELOCITY DATA FOR THE SACRAMENTO RIVER NEAR HOOD, CALIFORNIA, MAY 1978 TO SEPTEMBER 1981,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-01003

EROSION AND SEDIMENT CHARACTERISTICS OF THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,

Geological Survey, Salt Lake City, UT. Water Resources Div.
R. L. Seiler, and J. E. Tooley.
USGS Water-Resources Investigations Open-File Report 82-428, 1982. 44 p, 22 Fig, 10 Tab, 37 Ref.

Descriptors: *Sediment discharge, *Oil shale, *Utah, *Colorado, *Sediment yield, Channel erosion, Deposition, Particle size, Gully erosion, Unita Basin, White River, Source area sediment yield.

This report is part of a series describing the hydrologic characteristics of the southeastern Uinta Basin of Utah and Colorado, area of about 3,000 square miles. The mean annual suspended-sediment discharge of the White River at its mouth near Ouray (1975-79) was 1,759,000 tons (1,150 acre-feet) and for the White River near Colorado-Utah state line (1977-79) sediment discharge was 1,031,000 tons (675 acre-feet). The total-sediment yield for the area between these two stations for the period of concurrent record is calculated to be about 900 tons (0.59 acre-foot) per square mile per year. During snowmelt runoff from the lower basin (March) and later during snowmelt runoff from the upper basin (May and June) there are periods of large, sustained sediment discharges in the White River. During late summer, sediment discharge can increase significantly in response to thunderstorm runoff from normally dry tributaries. Large amounts of bed material are scoured from the lower White River channel during the annual peak flow, however, the mean streambed altitude does not change much because an equivalent amount of material is deposited in the channel during peak flow recession. (USGS)
W84-01036

WATER-QUALITY AND FLUVIAL-SEDIMENT CHARACTERISTICS OF SELECTED STREAMS IN NORTHEAST KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
H. E. Bevans.
USGS Water Resources Investigations Report 82-4005, 1982. 53 p, 2 Fig, 15 Tab, 17 Ref.

Descriptors: *Agricultural watersheds, *Water analysis, *Suspended sediments, *Chemical analysis, Sediment discharge, Sediment concentration, Streamflow, Statistical analysis, *Kansas.

In cooperation with the U.S. Soil Conservation Service, an investigation was made of the water-quality and fluvial-sediment characteristics of selected streams in northeast Kansas for which the construction of floodwater-retarding and grade-stabilization structures to control soil erosion is being considered. The predominent chemical type of water in streams draining the study area is calcium bicarbonate. In-stream concentrations of chemical constituents generally decrease with increasing streamflow. Exceptions to this are nitrate and phosphorus, which enter the streams as components of surface runoff. Computed mean annual discharges of dissolved solids ranged from 512 tons for Pony CratkSabetha, Kansas, to 23,900 tons for the Wolf River near Sparks, Kansas. Sediment yields in the study area, predominently silt and clay, are among the largest in the State. Drainage basins in the northern part of the study area yielded the most suspended sediment, with Pony Creek at Sabetha and near Reserve, Kansas, yielding 5,100 tons per square mile per year. Drainage basins in the southern part of the study area yielded less suspended sediment, with Little Grasshopper Creek near Effingham, Kansas, yielding 493 tons per square mile per year and Little Delaware River near Horton, Kansas, yielding 557 tons per square mile per year. (USGS)
W84-01045

2K. Chemical Processes

HYDROGEOCHEMICAL CYCLING IN A WATERSHED-GROUNDWATER SYSTEM: FORT RIVER AND CADWELL CREEK, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
For primary bibliographic entry see Field 5B.
W84-00967

2L. Estuaries

HYDROGEOCHEMISTRY OF THE NEW JERSEY PINE BARRENS,
Battelle Columbus Div., OH.
For primary bibliographic entry see Field 5B.
W84-00793

WATER QUALITY OF THE BARATARIA MARSH UNIT, JEAN LAFITTE NATIONAL HISTORIC PARK, LOUISIANA (APRIL 1981-MARCH 1982),
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00900

LITERATURE ASSESSMENT OF THE CHARLOTTE HARBOR ESTUARINE SYSTEM AND SURROUNDING AREA, SOUTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 10C.
W84-00992

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

UTILIZATION OF THE NEW MINERAL UF MEMBRANES FOR MAKING SEMI-HARD CHEESES,
Institut National de la Recherche Agronomique, Rennes (France). Dairy Technology Research Lab.
H. Goudedranche, J. L. Maubois, P. Ducruet, and M. Mahaut.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 243-258, 3 Tab, 8 Fig, 14 Ref.

Descriptors: *Membranes, Mineral membranes, *Ultrafiltration, *Cheese, Milk.

By using an ultrafiltration (UF) apparatus equipped with new mineral membranes making it possible to reach a protein content of 21% and a T.S. Content of 45%, making semi-hard cheese such as the French variety St. Paulin was studied. Properties of precheeses were characterized for defining optimum parameters of the proposed process. Acidification, addition of salt, renneting pH, and temperature were studied for their influence regarding the rheological behavior of the precheese and/or the organoleptic qualities of young and ripened cheese. Advantages of the process (increase of 19% of the cheese yield, no in-vat processing, possible addition of flavouring substances) are discussed. Performances observed with the new UF equipment (30 l of milk treated per hour per sq m) and its cleanability offer sufficient reliability to envisage an industrial scale up.
W84-00701

MEMBRANE PROCESSES FOR WATER, PULP AND PAPER, FOOD. STATE OF THE ART,
Alfa-Laval A.B., Tumba (Sweden).
R. Glimenius.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 259-272, 2 Diag.

Descriptors: *Membranes, Electrodialysis, Reverse osmosis, Ultrafiltration, *Desalination, *Pulp and paper industry, *Food industry, History, Economics, Reviews.

General trends, are presented on membra
esses for the water, pulp and paper, and
industry. Thus electrodialysis, reverse osm
ultrafiltration are considered from their
and economic aspects, and thoughts are
on how and why institutions and compa
entered this technology and which entitie
leading the development in the eighties.
W84-00702

**CONCEPTUAL DESIGN ASPECTS
VERSE OSMOSIS,**
Envirogenics Systems Europe, Leiden
lands).
D. Kuiper, and M. Mendia.
Desalination, Vol 35, Nos 1/2/3, Decem
(Comprising the Proceedings of the Symp
Membrane Technology in the 80's, Ystad,
Sept. 29 - Oct. 1, 1980), p 273-289, 3 Ta

Descriptors: *Reverse osmosis, Process
Costs, *Membranes, Desalination, Fouli
treatment.

The reverse osmosis process is used for a
different applications. As a result the desi
installations shows marked differences w
reflected in the cost of the process. T
relevant process variables are described i
to the process design and cost. These are
of pressure, feed quality, membrane confi
membrane fouling and pretreatment. The
ties of new membranes are discussed in
process applicability, possible improveme
cost reductions.
W84-00703

**MEMBRANE TECHNOLOGY IN TH
AND PAPER INDUSTRY,**
O. Olsen.
Desalination, Vol 35, Nos 1/2/3, Decem
(Comprising the Proceedings of the Symp
Membrane Technology in the 80's, Ystad,
Sept. 29 - Oct. 1, 1980), p 291-302, 15 Fig

Descriptors: *Reserve osmosis system, *M
technology, Membrane filtration, *Pulp a
industry, Lignosulphonate recovery, Lign
ery, Plate-and-frame membranes.

Membrane filtration is an industrial proce
pulp and paper industry. The rising de
environmental protection, energy saving
covery of valuable products has accele
application of membrane filtration. The
portant applications in the pulp and paper
are: (1) Recovery of valuable products - F
tion and purification of lignosulphonate fr
sulphite liquor; fractionation and purifi
lignin from kraft black liquor. (2) Energy
Concentration of dilute spent sulphite
brane filtration requiring lessenergy than
tion. (3) Environmental protection - Purifi
effluents from kraft bleach effluent. The D
system is a plate-and-frame system. DD
the development of membrane filtration in
and paper industry in 1971, and the first p
installed in 1973.
W84-00704

**ULTRAFILTRATION OF EFFLUENTS
SLAUGHTERHOUSES AND BRINE
MEAT INDUSTRY,**
M. Goldberg.
Desalination, Vol 35, Nos 1/2/3, Decem
(Comprising the Proceedings of the Symp
Membrane Technology in the 80's, Ystad,
Sept. 29 - Oct. 1, 1980), p 303-315, 2 Tab,
Ref.

Descriptors: *Ultrafiltration, Brines, *Me
essing industry, Slaughterhouses, Protein,
*Cruorin.

Ultrafiltration, when an integral part of a
processing system, makes it possbile to
this effluent and assist in depollution. U
tion of plasma from slaughterhouses is
which enables recovery of proteins. The d
duction of proteins (plasma and cruorin

d at approximately 60 tons. As to the brine this can be treated in order to concentrate teins and diminish the salt concentration. 705

CATION OF SELECTIVE MEMBRANES PE JUICE STABILIZATION,
e Univ. (Yugoslavia). Faculty of Agricul-

tic-Aleksic, and M. M. Jaksic.
ation, Vol 35, Nos 1/2/3, December 1980 ising the Proceedings of the Symposium on ane Technology in the 80's, Ystad, Sweden, - Oct. 1, 1980), p 317-327, 1 Tab, 6 Fig, 19

tors: *Membranes, *Electrodialysis, Food ng industry, *Grape juice, Potassium tar-

trodialytic membrane separation procedure e juice stabilization from potassium tartrate ation was investigated. The most promising ng was achieved by cationic membrane particularly with DuPont's Teflon-based 390. Potassium ions were removed below tical content defined by the solubility prod- tartrate ions, while the acidity remained olerable limits. The separation process fol- araday's law of electrolysis down to the haustion of potassium ions thereby provid- ctly the contact time for the stabilization. same time it represents a new economical drastically reduce potassium ion content in amount of juice and further to adjust the mposition by mixing it with larger quanti- raw material. Cationic-anionic membrane r both potassium and tartrate ionic separa- re also tried. The effect of electrodialytic on on grape juice composition and stability estigated.
706

RANE TECHNOLOGY AND BIOTECH-GY,
d Univ., CA.
ichaels.
ation, Vol 35, Nos 1/2/3, December 1980 ising the Proceedings of the Symposium on ane Technology in the 80's, Ystad, Sweden, - Oct. 1, 1980), p 329-351, 18 Fig.

tors: *Membranes, Biotechnology, *Re- smosis, *Ultrafiltration, Fermentation, *Bio- ry, Reviews.

ane and membrane-separation technology is increasing attention as a means for cultur- icroorganisms, recovering and isolating abile products, and disposing of objection- xic wastes. Continuous crossflow filtration icroporous or ultrafiltration membranes is sed to separate cells from supernatant in fermentation broths with high product re- and elimination of a major waste-disposal n. Reverse osmosis and ultrafiltration are g attention for concentrating fermentation to facilitate final product recovery, or for ralizing or removing colloidal impurities product-containing solutions to improve t yield and purity. Hollow-fiber membrane serve as excellent 'artificial capillary beds' maintenance of mammalian cell cultures; artificial organs, and for the production of es, viruses, vaccines, and antibodies for di- c and therapeutic uses. Hollow-membrane are attractive media for the growth and t of microbial (bacteria, yeast, etc.) popula- very high cell densities (ten to the twelfth per sq cm), and may provide the basis for a mily of high-capacity, continuous-produc- ioreactors. Immobilized enzyme reactors, employ membranes as matrices for enzyme ment, are now gaining increasing populari- he conduct of continuous biochemical trans- ions. Enzyme-containing membranes prom- elopment of novel electrochemical and ther- mic sensors for detection and measurement plex biochemical substances; they are ex- to play an important role in the design of control instrumentation for biochemical manufacturing processes.
W84-00707

BIOCATALYSIS BY MEMBRANE-ATTACHED ENZYMES AND WHOLE MICROBIAL CELLS,
(Heinz (H.J.) Co., Pittsburgh, PA.
K. Venkatsubramanian.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 353-363, 8 Tab, 5 Ref.

Descriptors: *Membranes, *Enzymes, Biocatalysis, Microbial cells, Collagen, *Microbiological studies.

Bioconversion processes employing fixed enzymes and whole microbial cells is becoming a well-established art. A wide variety of inorganic and organic carrier matrices, as well as immobilization procedures, were employed for immobilizing enzymes or microbial cells. While the preferred physical form of these biocatalysts often tends to be pellets or beads used in a packed bed reactor, the membranous form offers several unique advantages over such reactor designs. Research effort was expended over the past decade in the development of biocatalytic reactor systems based on enzymes and cells immobilized on reconstituted collagen membranes. The key features of biocatalysis are highlighted.
W84-00708

MEMBRANE TECHNOLOGY APPLIED TO BIOCONVERSION OF MACROMOLECULAR SUBSTRATES AND UPGRADING OF PRODUCTS. A MODEL STUDY ON ETHANOL PRODUCTION FROM CELLULOSE,
Lund Univ. (Sweden). Dept. of Technical Microbiology.
B. Hagerdal, M. Lopez-Leiva, and B. Mattiasson.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 365-373, 1 Tab, 5 Fig, 26 Ref.

Descriptors: *Membranes, Economics, *Reverse osmosis, Bioconversion, Enzymes, Cellulose, Ethanol, *Alcohols, Separation techniques.

The use is discussed of membrane reactors for enzymatic degradation of macromolecular substrates in order to reduce product inhibition. In this study the degradative step is integrated with a process line containing reverse osmosis as well as bioconversion utilizing co-immobilized enzymes and microorganisms. This concept of a combination of membrane technology and biotechnology takes into account not only the fact that bioconversions generally are controlled by product inhibition but also that dilute product solutions will be obtained when these bioconversions are continuously operated. Bioconversions have to be optimized with respect to productivity as well as product concentration. When taking membrane technology into account these optimizations may concentrate more on productivity since the resulting dilute product stream can be upgraded in a suitable membrane unit operation.
W84-00709

MEMBRANE TECHNOLOGY AND COSTS; STATE OF THE ART,
Lund Univ. (Sweden). Dept. of Business Administration.
B. Bjerke.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 375-382.

Descriptors: *Membranes, *Economics, Reviews, Costs, Membrane processes, Separation techniques.

It is impossible to make calculations which are generally valid. There are too many assumptions which must be established before an individual case can be calculated, e.g., concerning volume treated, operating period, and membrane life. One can think of an 'average' situation looked at from such a systems level that components can be distinguished, i.e., (1) pretreatment, (2) reverse osmosis membranes (3) post-treatment (4) support systems, and (5) acceptance test. From this point of view one can easily find crucial factors such as membrane, operating/cleaning labor, and depreciation costs. Some industries are more suitable than others from an economic point of view, e.g. woodpulp, dairy, and foodstuff. Generally there are questions which are seldom asked. Such are the role of opportunity costs, start-up problems, and costs from help of experts. There are several advantages from using membrane technology for concentration, e.g. less need of energy, smaller installations, and environmental advantages. These factors will be stressed even more in the future. Membrane technology has therefore come to stay.
W84-00710

MEMBRANE LIFE, CAPACITY AND COSTS,
Paterson Candy International Ltd., Laverstoke (England).
D. Pepper.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 383-396, 5 Tab, 5 Fig, 7 Ref.

Descriptors: *Membranes, Membrane processes, Seawater, Brackish water, *Costs, Dairy industry, Food processing industry, Chemical industry.

Membrane life is determined as much by the way that the system containing the membrane is designed and used as by the chemical and physical stability of the membrane. Membrane life is not a fundamental property of the membrane. All membranes suffer from a gradual loss of throughput because of creep under the applied stress but this is predictable and can be allowed for in design. Chemical attack can be quantified and operating limits set to minimise it. Membranes already exist with adequate lifetimes for the treatment of brackish and seawaters and for applications in the dairy, food, and pharmaceutical industries. Many other applications will become possible, for example in the chemical industries, when more resistant membranes are available.
W84-00711

SYSTEM OPTIONS AND COSTS IN DAIRY ULTRAFILTRATION,
Alfa-Laval A.B., Lund (Sweden).
P. Dejmek, and H. Engwall.
Desalination, Vol 35, Nos 1/2/3, December 1980, p 397-400, 6 Fig, 2 Ref. (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980).

Descriptors: *Ultrafiltration, *Costs, Dairy industry.

The costs of ultrafiltration continue to be the focus of attention of presumptive users. While the cost structure of the total costs is well documented, the internal structure of the capital costs of ultrafiltration is less widely known. A breakdown of the first costs of typical dairy systems as delivered by Alfa-Laval is presented.
W84-00712

MEMBRANE PROCESSES FOR WATER SUPPLY AND REUSE - A QUESTION OF ENERGY CONSUMPTION AND COST,
Vattenbyggnadsbyran Ltd., Stockholm (Sweden). Div. for Water, Soil and the Environment.
B. Ericsson.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 401-421, 11 Tab, 9 Fig, 15 Ref.

Descriptors: *Desalination, Desalination plants, Brackish water, Seawater, *Water supply, Water reuse, Membrane processes, Reverse osmosis, Energy, Costs, MSF-RO dual-purpose,

Wastewater treatment, Multistage flash, Salbukh, Riyadh, Saudi Arabia.

Desalination of brackish water and seawater with reverse osmosis (RO), with special emphasis on costs and energy consumption, is discussed. Some aspects of and development trends in industrial and domestic applications of membrane processes are also taken up, particularly with regard to by-product recovery and water reuse in connection with advanced wastewater treatment. The first RO plant to be brought into operation in Riyadh, Saudi Arabia, is located at Salbukh. The investment and total operation costs for this plant have been calculated. The water cost is at least twice as high as in a continental U.S. location, due the very high cost of civil and local works in Saudi Arabia. A similar calculation has been made for RO seawater desalination. Increased energy costs during the last decade have directed R and D work for all desalination methods towards reducing energy consumption. Energy recovery in connection with RO seawater desalination is particularly feasible. Different methods for energy recovery are reported, the preferred methods depending on the size of the RO plant. A large underground RO plant for energy recovery, based on utilization of the static pressure instead of high pressure pumps, was studied. Another possible energy-saving, but also water quality improving method is proposed, viz. a combined multistage flash (MSF)-RO dual purpose plant. Excess power for RO seems to be more and more available in Saudi Arabia due to the high power/water ratio in MSF dual purpose plants compared to the real demand for power and water.
W84-00713

PRECONCENTRATION BY REVERSE OSMOSIS BEFORE EVAPORATION - POSSIBILITIES IN SWEDEN,
Lund Inst. of Tech. (Sweden). Div. of Chemical Engineering.
P. Eriksson.
Desalination, Vol 35, Nos 1/2/3, December 1980, p 423-429, 1 Tab, 2 Fig. (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980).

Descriptors: *Membranes, *Reverse osmosis, *Energy, Pulp and paper industry, Dairy industry.

An inventory was made on how much water is removed by evaporation in Sweden, and where it is technically and economically possible to save energy by preconcentration by reverse osmosis. It is possible, mainly in the pulp and paper and dairy industries. Annual savings of energy equivalent to 38,000 and 11,000 metric tons of oil, respectively, can be achieved in these industries.
W84-00714

CLOSING REMARKS,
Svenska Traeforskningsinstitutet, Stockholm.
L. Stockman.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 431.

Descriptors: *Membrane processes, Membranes, Reviews, *Sweden.

Membrane techniques are in a state of rapid, dynamic development in which very capable people, institutes and companies are involved. Companies, especially Swedish, are encouraged to join the Swedish Membrane Technology foundation.
W84-00715

PROCEEDINGS OF THE INTERNATIONAL CONGRESS ON DESALINATION AND WATER REUSE, MANAMA, BAHRAIN, NOV. 29-DEC. 3, 1981,
Fairleigh Dickinson Univ., Teaneck, NJ.
M. Balaban, and R. Bakish.
Desalination, Vol 39, Nos 1/2/3, November 1981, p 1-532. International Desalting and Environment Association.

Descriptors: Desalination, Desalination plants, Distillation, Reverse osmosis, Electrodialysis, Solar distillation, Pretreatment, Scaling, Materials engineering, Energy, Economics, Management planning, Education, Middle East, American Continent, Europe, Mediterranean, Asia, Far East.

Second and final volume of these Proceedings of the international congress on desalination with the participation of scientists and engineers in the field. This volume contains 54 papers on Instrumentation, New energy sources, The Middle East, The American continent, Europe and the Mediterranean, Asia and the Far East, Energy and Economics, Education and Management, Related Topics. (Volume 38 of Desalination constitutes the first volume of the Proceedings).
W84-00716

DISTRIBUTED CONTROL SYSTEMS FOR DESALINATION,
Catalytic, Inc., Philadelphia, PA.
E. V. Kelley.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 3-21, 7 Fig, 6 Ref. (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, *Computers, *Control systems.

Historically, desalination applications have not utilized direct computer control due to the relative simplicity of the typical desalination control systems, the cost of direct computer control, and the heretofore sophisticated operation and maintenance procedures required to implement a direct computer controlled system. As the size of desalination plants has increased for facilities in the Middle Eastern countries, the need for energy management and data acquisition has appeared in the form of ancillary computer systems in addition to the standard analog control system for the facility. An overview is presented of typical distributed control systems which have become more readily available in recent years. Emphasis is placed on the steps which have been taken by various manufacturers to simplify the implementation, operation, and maintenance of currently available systems and the importance of monitoring significant process variables which affect operating efficiency and the physical condition of the plant.
W84-00717

TODAY'S STATUS OF PH MEASUREMENT AND CONTROL IN DESALINATION PLANTS,
Foxboro Co., MA.
F. E. Moore.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 23-31, 4 Fig, 2 Ref. (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Instruments, *Multistage flash, *Reverse osmosis, *Hydrogen ion concentration, Acid-dosing, Electrolyte dosing.

Horror stories about desalination plants are rampant: acid-dosed multistage flash plants needing retubing after two years; electrolyte-dosed plants working a little longer, reverse osmosis plants needing new membranes in a few years. Some of these troubles are blamed on poor hydrogen ion concentration measuring equipment. In an effort to determine today's real situation regarding hydrogen ion concentration measurement, a survey was conducted of the entire membership of the International Desalination and Environmental Association. The results prompted further in-depth discussions with knowledgeable people in the desalination field. This paper is based on the survey, the in-depth discussions, and 20 years of experience in the hydrogen ion concentration measurement field.
W84-00718

INSTRUMENTATION PROBLEMS IN LIBYN DESALINATION PLANTS,
Alfateh Univ., Tripoli (Libya).
H. El Hares.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 33 (Abstract only). (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination pla
strumentation, *Libya.

Some interesting instrumentation problem
their solutions occurring in the main Libyan
nation plants of West Tripoli, Zuwara, Sirte,
and Beghazi-North are presented. Also co
sons are made and actual working life giv
key instruments of different manufacturers.
W84-00719

**CONTROL AND INSTRUMENTATION
RIENCE AT LOK ON PAI MSF SEAW
DESALINATION PLANT,**
Binnie and Partners, London (England).
A. R. George, and B. Tyler.
Desalination, Vol 39, Nos 1/2/3, p 35, Dec
1981 (Abstract only) (2nd Vol. Proc. of Int.
gress on Desalination and Water Reuse, Ma
Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination
*Distillation, Seawater, *Multistage flash, L
Pai.

Critical measurements are discussed in mult
flash seawater distillation plants. These are h
gen ion concentration and dissolved oxygen i
and their associated control systems and the
tinuing acquisition and evaluation of cor
data. The use of central processor to aid eval
of date is described. Practices recommende
enhancing performance and security are given
W84-00720

**AN INTRODUCTION TO NEW ENE
SOURCES FOR DESALINATION,**
CH2M Hill Southeast, Inc., Gainesville, FL.
O. K. Buros.
Desalination, Vol 39, Nos 1/2/3, December
p 37-41, 23 Ref, (2nd Vol. Proc. of Int. Con
on Desalination and Water Reuse, Manama,
29-Dec. 3, 1981).

Descriptors: *Desalination, *Energy sources,
stills.

The papers presented in the section 'New En
Sources for Desalination' illustrate that a varie
new energy sources are being utilized to pro
power for desalination. However, aside from
stills there is only limited experience with
scale facilities using these new sources. The fu
of desalination with new energy sources dep
on reducing the costs of producing reliable en
conversion devices and increasing the efficienc
the desalination units.
W84-00721

**AN ASSESSMENT OF THE MARKET POT
TIAL FOR SMALL SOLAR POWERED
SALINATION PLANTS,**
Kara Establishment, Jeddah (Saudi Arabia).
J. J. Turnage, and A. A. Husseiny.
Desalination, Vol 39, Nos 1/2/3, p 43-52, Dec
ber 1981, 4 Tab, (2nd Vol. Proc. of Int. Cong
on Desalination and Water Reuse, Manama, N
29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination pla
*Solar energy, Middle East, Small solar powe
desalination(SSPD).

The introduction of a new technological systen
the commercial market is helped by following
tablished procedures for estimating the poten
market for the product. The results are descri
of a preliminary market analysis for the manu
ture and sale of small solar-powered desalinat
(SSPD) systems in Middle Eastern Countr
Overall results indicate that manufacture and s
of the SSPD system are promising from both te
nical and economical standpoints. Until prototy
are built, some caution is indicated for financin
production and for purchasing of equipment. P
totype systems are being developed to demonstr
in actuality the commercial acceptance and e
nomic viability of the system.
W84-00722

OF A COMMERCIAL SOLAR-
ED GREENHOUSE,
ablishment, Jeddah (Saudi Arabia).
Kasabi, S. I. Abdel-Khalik, T. E. Dix, R.
, and A. A. Husseiny.
ion, Vol 39, Nos 1/2/3, p 53-62, 5 Fig, 2
ef. (2nd Vol. Proc. of Int. Congress on
ion and Water Reuse, Manama, Nov. 29-
981).

ors: Desalination, Desalination plants,
rgy, Greenhouses, Irrigation.

etely solar-powered greenhouse complex
ned for climate controlled food produc-
t, humid environments. The concept uses
esign features to provide irrigation water
e water sources. The overall system con-
scussed along with the solar still subsys-
h has been designed to provide a continu-
water supply. While incorporating many
e features, the use of proven technologies
ve design results in a system that should
economically with current, more tradi-
igns.
23

ESULTS FROM A SOLAR BOILER
INE WATER DISTILLATION,
a Univ., Berkeley. Sea Water Conversion

di, and B. W. Tleimat.
ion, Vol 39, Nos 1/2/3, December 1981,
5 Fig, 10 Ref, (2nd Vol. Proc. of Int.
on Desalination and Water Reuse,
Nov. 29-Dec. 3, 1981).

ors: *Desalination, Desalination plants,
stillation, *Multieffect flash, Distillation,
s, Flat plate solar collector.

ormance of a low temperature, 50-70C,
er is presented. The boiler consisted of a
azed flat-plate solar collector, a flash
a water cooled surface condenser, a cir-
pump, and a temperature-controlled pre-
simulate constant temperature thermal
Data were obtained on this boiler from
1980 to May 1981. During this period, the
eous total incident solar radiation at noon,
red by a pyranometer in the plane of the
ranged from 0.7 to 1.0 kW per sq m and
al total incident solar radiation ranged
to 29 MJ per sq m per day. At these
s the instantaneous efficiency of the col-
nged from 30 to 55 percent while the
fficiency ranged from 20 to 44%. The
nce of the solar collector was the domi-
or in determining the performance of this
ow temperature steam, 50 to 70C, from
ers can be produced to drive multieffect
n systems using high performance evapo-
desalting sea water.
24

OF A SMALL SOLAR-POWERED DE-
TION SYSTEM,
nst. of Tech., Melbourne.
wman, A. M. El-Nashar, B. H. Thrasher,
sseiny, and A. J. Unione.
ion, Vol 39, Nos 1/2/3, December 1981,
4 Fig. (2nd Vol. Proc. of Int. Congress on
ion and Water Reuse, Manama, Nov. 29-
981).

ors: Desalination, Desalination plants,
rmal system, Reverse osmosis.

is presented for a solar/thermal system
d to power a reverse osmosis (RO) desali-
it to produce 7000 gallons of fresh water
r period. A field of line-focus tracking
llectors is used to heat a high pressure
por water storage tank supplying two
d reciprocating steam engines, one direct-
d to the RO high-pressure pump and the
an electric generator for auxiliary power.
iary heating loop with an oil-fired boiler is
l to supply the steam engines. The system
in either all-solar, all-oil, or mixed solar/
s. Primary operating mode is assumed to be a mixed solar/oil mode in which the oil-fired boiler is used only to prevent shutdown of the RO system during the course of a partly sunny day. In this mode, the RO system does not come on line in the morning until the solar collector field has brought the high-pressure storage tank to a point near maximum operating pressure. Thereafter, the oil-fired boiler comes on automatically whenever the storage tank is drawn down to a pressure near minimum full-power operation (due to inadequate or intermittent insolation) and remains on, supplying the steam engines, until the solar collectors have again brought the storage tank to the high-pressure cutoff. In the all-solar mode, the system continues to operate at reduced power as storage tank pressure drops below the point at which the oil-fired boiler would otherwise come on. A portion of the RO system is shut down to maintain pressure in the remainder. The all-oil mode is used whenever fresh water is required during non-sunny periods, or to increase fresh water production in sunny periods.
W84-00725

SOLAR DISTILLATION: THE SOLAR-DRIVEN CASE,
Sydney Univ. (Australia).
J. P. Gerofi, G. G. Fenton, and E. Mannik.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 83-94, 8 Fig, 1 Tab, 14 Ref, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Solar distillation, Economics, Solar stills.

Distillation systems are discussed where all the plant's thermal energy requirements are provided by solar energy. Fairly small capacity plants are considered operating in remote arid regions. Such systems consist of solar collectors and thermal storage coupled to a distillation plant. Each of these aspects is considered as well as the type of control strategy to be used. Using a dynamic computer simulation model, two solar-driven systems are considered: one using flat-plate collectors and a 76C multiple-effect evaporator (MEE) desalination plant, the other using evacuated tubular collectors and a 95C MEE plant. Various combinations of collector area and thermal storage volume are considered, and optimal values determined for each case. For the particular example chosen (100 cu m/day, located at 23 1/2 deg S) the flat-plate collector system was superior at current prices, giving an overall water cost of $5.82/cu m versus $7.34 for the second system. Both these costs are considerably less than water costs from conventional solar stills.
W84-00726

COMPARISON OF SOLAR RO AND SOLAR THERMAL DESALINATION SYSTEMS,
Sydney Univ. (Australia).
J. P. Gerofi, and G. G. Fenton.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 95-107, 1 Fig, 8 Tab, 11 Ref, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Solar reverse osmosis, Solar distillation, Economics, *Solar energy, Reverse osmosis.

The unit water costs from 100 cu m/day solar reverse osmosis (RO) and solar distillation plants are compared. RO plants powered by photovoltaic cells are already available, and distillation plants operated from solar collectors are being constructed. For the size chosen and these options it is concluded that distillation is cheaper than RO for salinities above about 6,000ppm. Solar ponds can provide both thermal and electrical energy more cheaply than the above options, but they do not yet have the market penetration of the more accepted systems. If solar ponds are used then distillation is cheaper than RO only for salinities above about 10,000ppm.
W84-00727

DESIGN AND OPERATION EXPERIENCE WITH SOLAR POWERED MULTISTAGE DESALINATION PLANTS,
Ecole Polytechnique Federale de Lausanne (Switzerland).
R. Kriesi.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 109-116, 2 Fig, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Solar energy, *Solar distillation, *Multistage flash, Distillation, Kuwait.

Desalination is a favourable application for solar energy and has a good potential for economic viability, since water demand is a consequence of abundant irradiation (no long term storage needed) and only low temperatures are necessary for the required thermal energy (simplicity of solar collector system). An R and D partnership for the development and implementation of solar desalination technology has been set up between the Swiss Federal Institute of Technology (fundamental development and laboratory testing), Atlantis Energy Ltd. (hardware design, construction and delivery) and the Kuwait Institute for Scientific Research (field testing). A 3-phase program is under way: Phase 1 (completed): Initial construction of a conventional MSF plant, laboratory and field tests. Design criteria for solar equipment resulted such as capability of operation under heavily fluctuating energy input conditions, minimization of mechanical energy consumption, simplicity of equipment, etc. Phase 2 (completed): Design of a new 'real solar' MSF-unit, meeting the above requirements, laboratory testing, field testing in Kuwait. Phase 3 (under way): Upscaling of the pilot plant to commercial sizes of 100 to 1000 cu m/day, optimization of the process, realization of a demonstration plant, coupled to a salt solar pond, specially developed for this purpose. Solar desalination has been demonstrated to be a reliable method of obtaining drinking water when using a specially developed salt solar pond system as heat source, water at lower prices is obtained compared with that from an oil-fired evaporator.
W84-00728

SOLAR DESALINATION: PROTOTYPE 'PITHON' A SPECIAL SOLAR MULTIPLE-EFFECT DISTILLER,
CEA Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette (France).
J. C. Deronzier, F. Lauro, and R. Ployart.
Desalination, Vol 39, Nos 1/2/3, Dec. 1981, p 117-123, 4 Fig, (2nd Vol. Proc. of International Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Solar multi-effect distillation, Solar distillation, Arabian Gulf, 'Pithon' prototype, Hagevap treatment.

Solar distillation is one of the future solutions to producing fresh water from the sea or from brackish water. The international market capacities range from 100 to 200 or 300 cu m/d. The French Atomic Energy Commission has designed a new type of evaporator which permits a good adaptation to solar collectors under the conditions of Arabian countries. A horizontal submerged tube multiple-effect process is used, operating at low temperature under atmospheric pressure (T<70C) with Hagevap treatment. This process is well known in countries of the Arabian Gulf particularly in Kuwait. Operating at low temperatures avoids scaling and corrosion problems. Multiple-effect gives a very high performance ratio and low electrical consumption for pumping.
W84-00729

WIND AND SOLAR POWERED REVERSE OSMOSIS DESALINATION UNITS-DESIGN, START UP, OPERATING EXPERIENCE-,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
G. Petersen, S. Fries, J. Mohn, and A. Muller.
Desalination, Vol 39, Nos 1/2/3, p 125-135, December 1981, 8 Fig, 1 Tab, 5 Ref, (2nd Vol. Proc.

of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: Desalination, Desalination plants, Reverse osmosis, Solar energy, Wind, Plate modules, Photovoltaic solar generator, Wind converter, Mexico, Suderoog Island, Germany.

To demonstrate the operation of reverse osmosis (RO) units with GKSS plate modules coupled with unconventional energy supply systems, two projects are presently carried out by the GKSS research center applying a photovoltaic solar generator and a wind energy converter for a site in the Northern part of Mexico and a small island at the German coast of the North Sea, respectively. The solar generator with a designed peak power of 2.5 kW is developed by AEG and powers a RO unit for the desalination of brackish well water. The plant has been installed in Concepcion del Oro, Zacatecas, in spring 1980 and has been operated by the Mexican company DIGAASES in cooperation with AEG and GKSS since May 1980. The second project is a 6- kW wind-energy converter supplying 3 RO modules with a total membrane area of 30 sq m. After comprehensive component tests at the GKSS research center at Geesthacht the plant was installed at the very small island of Suderoog at the German coast of the North Sea. Test operation was started in December 1980.
W84-00730

WASTE HEAT POWERED REVERSE OSMOSIS PLANTS,
Envirogenics Systems Co., El Monte, CA.
R. A. Tidball, and R. Kadaj.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 137-145, 3 Fig, 4 Tab, 2 Ref, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Biphase, Turbine, *Waste heat.

The purchased power required for operation of reverse osmosis (RO) systems can be greatly reduced or sometimes eliminated by reclaiming waste heat from diesel engines, gas turbines, flare gases, etc. This can be accomplished by using a biphase turbine to convert low level waste heat to shaft horsepower. The system can be designed to use waste heat from existing installations or to reduce the size of the generating equipment in new supplies. The biphase conservation turbine is driven by a two phase stream generated by flashing a superheated liquid through a nozzle to the turbine. The turbine can be directly coupled to a pump shaft, to an electrical generator or to a combination of the two. Performance of the turbine is discussed. The waste heat recovery turbine and a hydraulic turbine to recover energy from the high pressure concentrated brine can be combined into one system. The design is described of a seawater RO system using waste heat from an existing diesel generating unit. The system is designed to produce 750 cmd of 400-ppm water at an energy consumption of approximately 2.5 KWH of purchased power p/cu m. A discussion of available desalination capacity at various quantities and temperature levels of the waste heat is presented. A comparison of water costs obtained using this system and a conventional electrical drive is presented.
W84-00731

USABILITY OF LOW TEMPERATURE WASTE HEAT FOR SEA WATER DESALINATION,
Nord-Aqua Oy, Espoo (Finland).
R. Saari.
In: Desalination, Vol 39, Nos 1/2/3, December 1981, p 147-158, 9 Fig, 3 Ref. (2nd Vol Proc of Int Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Multieffect distillation, Seawater, *Waste heat.

Waste heat energy that is cooled away from a process appears at two very different temperature levels. The waste heat that is 50C warmer than the ambience, can be utilized by a multieffect-distillation process, and it is competitive to utilize it at least as thoroughly as the first-rate energy. At low temperatures, less than 20C above the ambient temperature, waste heat can be technically, and economically utilized, if the temperature difference is 7 to 15C, depending on the pumping energy cost.
W84-00732

OCEAN THERMAL ENERGY AND DESALINATION,
Alsthom-Atlantique, Grenoble (France). Neyrtec Div.
M. Rey, and F. Lauro.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 159-168, 5 Fig, 3 Tab, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Ocean circulation, *Thermal power, *Energy conversion, *Temperature gradient.

In 1981, the French physicist d'Arsonval was the first to suggest the harnessing of the temperature difference between the warm surface layers and cold deep layers of tropical oceans. Since then, several attempts have been made to convert this undepletable supply of thermal potential energy into mechanical energy and, later, into electricity. In recent years, various countries including France have launched thermal energy conversion (OTEC) programs. Tropical regions with useful temperature differences often lack both conventional energy resources and potable water. In such regions, OTEC plants could be used with advantage for the simultaneous production of power and desalinated seawater. An original seawater distillation scheme using surface water and the cold reject stream from an OTEC cycle is discussed. Power not required for distillation may be exported outside the plant. The combined distillation and OTEC scheme is compared with conventional desalination plant producing both potable water and electricity. The OTEC scheme appears highly flexible and shows considerable economic promise.
W84-00733

DEVELOPMENT OF SOLAR DESAL, A CODE FOR MODELING, SIMULATION AND DESIGN OF SOLAR DESALINATION SYSTEMS,
Science Applications, Inc., Ames, IA.
T. E. Dix.
Desalination, Vol 39, Nos 1/2/3, December, 1981, p 169-170 (Abstract only) (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination apparatus, *Solar distillation, Wind, Solar stills.

A computer code has been developed as a tool to aid design work of wind-powered and solar-powered desalting plants. The code accommodates for various solar energy sources deliver systems and RO and ED processes. Flow charts are presented with detailed description of the code, capability and limitations. The SOLAR DESAL program could also be used to simulate desalination units of reverse osmosis and electrodialysis which employ diesel generators.
W84-00734

ENGINEERING DESIGN OF A 6000 CU M/DAY SEAWATER HYBRID RO-ED HELIO-DESALTING,
Science Applications, Inc., Ames, IA.
A. A. Husseiny, and H. L. Hamester.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 171-172 (Abstract only) (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Desalination apparatus, Reverse osmosis, Solar plant, Electrodialysis, *Solar energy.

Employment of solar energy as a power source for desalination processes has been thought of as an

evaluation of the solar stills which have
operation for a long period of time.
recent efforts to commercialize active coll
solar radiation, interest in developing
powered desalting systems has been
Among the new viable concepts is the de
hybrid reverse osmosis-electrodialysis co
plant to desalt seawater. The design is base
development of a stand-alone system that
6,000 cu m/day at a minimum cost of
which can eventually compete with cost
from conventional desalting plants. A
design description, design parameters and c
mates are provided.
W84-00735

DEVELOPMENT OF A MARINE OS SOLAR STILL FOR A SEA WATER D NATION,
Ames-Ridgefield, Inc., IA.
R. Knighton.
Desalination, Vol 39, Nos 1/2/3, Decemb
p 173 (Abstract only) (Comprising 2nd Vo
of Int. Congress on Desalination and Wate
Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination
Desalination apparatus, Solar energy, Mem
*Solar stills, Seawater, *Marine osmotic so

The development of a marine osmotic solar
seawater desalination is described. Results
rial tests and simulation system analysis are
ed. A comparison is made with convention
stills and solar powered membrane desa
processes. Results of extensive marketing r
are reported for various applications of th
ess.
W84-00736

SOLAR POWER/DESALINATION, P SYSTEM,
Miami Univ., Coral Gables, FL. Lab. for
Research.
G. Kvajic.
Desalination, Vol 39, Nos 1/2/3, Decembe
p 175 (Abstract only) (Comprising 2nd Vol
of Int. Congress on Desalination and Water
Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination
*Electrodialysis, Seawater, *Photovoltaic s

Photovoltaic/Electrodialysis, PV/ED, pow
salination system is studied in which the se
feed is heated in the PV-cells. By varyin
concentration and temperature of the P
system, one can control the ratio of pow
water production within a large range s
various demands for power and water can b
W84-00737

RELIABILITY OF THE JEDDAH SEAW RO DESALINATION PLANT BASED U OPERATIONS EXPERIENCE,
Iowa State Univ., Ames.
I. I. Kutbi, A. M. Metwally, Z. A. Zabri, and
A. Husseiny.
Desalination, Vol 39, Nos 1/2/3, p 179-191,
7 Tab, 10 Ref, (2nd Vol. Proc. of Int. Congr
Desalination and Water Reuse, Manama, No
Dec. 3, 1981).

Descriptors: *Desalination, Desalination
Seawater, *Reverse osmosis, Jeddah, *Relia
Saudi Arabia.

Demand on commercial reverse osmosis
seawater desalination plants can be assured
increase in reliability and with high levels o
formance. Such improvements can be
achieved through 'lessons learned' from expe
gained in available RO systems such as the
Jeddah RO plant. Critical components
affect plant performance were identified and
ods of improving the design are recomme
Failure data was extracted from operation
maintenance reports. An assessment is made
impact of failures and outages on the availabi
the RO desalination plant. The single largest

he effective capacity of a water supply ased on RO desalination of seawater is ilability and maintainability. The design tion of the plant has an impact on the lity of water supply system performance. 8

MANCE EVALUATION OF MSF , THE CASE OF JEDDAH PLANTS,
e Univ., Ames.
i, Z. A. Sabri, and A. A. Husseiny.
ion, Vol 39, Nos 1/2/2, December 1981, , 5 Fig, 9 Tab, 9 Ref, (2nd Vol. Proc. of gress on Desalination and Water Reuse, Nov. 29-Dec. 3, 1983).

rs: Desalination, *Desalination plants, ance evaluation, Multistage flash distilla- lah, Saudi.

rmance is reviewed of the Jeddah desali- nt during a period of 8 years of operation le insight into actual plant experience. re extracted from plant monthly reports tenance orders. The analysis provided sed on objective evaluations of operations experience and is directed towards assess- problems that can be mitigated in new f MSF plants and recommendations for ent or modifications of existing designs lures.
9

MANCE STUDY OF WATER DESALI- METHODS IN SAUDI ARABIA,
y of Petroleum and Minerals, Dhahran abia).
adhah, and C. K. Wojcik.
ion, Vol 39, Nos 1/2/3, December 1981, , 2 Fig, 4 Tab, 3 Ref, (2nd Vol. Proc. of gress on Desalination and Water Reuse, Nov. 29-Dec. 3, 1981).

rs: Desalination, *Desalination plants, , Brackish water, Multistage flash distilla- verse osmosis, Electrodialysis, *Perform- uation, *Saudi Arabia, Reviews.

abia is an arid desert country without sweet water lakes, however, it does have ount of groundwater and seawater. In make these waters suitable for human tion and industrial use, most of their salts removed by some means. The desalination most frequently used in the Kingdom are: ge flash (MSF) evaporation, reverse osmo- and electrodialysis (ED). During the last A spectacular growth of desalination as occured. This growth is expected to in the next decade. The present produc- city of all desalting plants in Saudi Arabia ted to be 750,000 cu m/day; this figure nost likely tripled in the next five years. formance was studied of the most signifi- alination plants in the Kingdom. The which include MSF and seawater and water RO plants, were selected either of their size or their importance to the ion technology. The plants are briefly de- nd their performances are discussed.
40

TIONAL EXPERIENCE OF 2 X 11,500 ER 3 D MSF SEAWATER DESALINA- LANT,
f, M. Alarrayedh, and A. M. Alawadi.
tion, Vol 39, Nos 1/2/3, December 1981, 7, 2 Fig, 3 Tab. (2nd Vol. Proc. of Int. s on Desalination and Water Reuse, , Nov. 29-Dec. 3, 1981).

ors: *Desalination, Desalination plants, ion, Seawater, *Multistage flash distilla- hrain, Bare carbon steel, Corrosion, *Steel.

rational experience with two 11,500 cu m/ tage flash desalination plants which were in Bahrain in 1976. On attempt to place in tive the problems which this technology is d. The particular difficulties which result- ed from use of bare carbon steel are identified. The corrective measures which were taken to minimize the rate of corrosion are stated. Careful specifications of materials for such plants is essential, and the necessary expertise must be available at start up to achieve stable operation and to minimize down time.
W84-00741

EXPERIENCE IN COMMISSIONING LARGE DESALINATION PLANTS IN THE MIDDLE EAST,
Weir Westgarth Ltd., Glasgow (Scotland).
D. W. Black, and R. M. Morris.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 229-239, 1 Fig, 1 Tab. (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, *Multistage flash distillation, Middle East.

Aspects of the design and construction of three major seawater multistage flash installations, with some 14 evaporators each producing about 5 mgd (22,000 cu m/d) are briefly reviewed. Initial problems were encountered with brine weir design at high brine rates, and painting. Remedial action was successfully incorporated in later plants in spite of the short timescale available. Recirculating brine pump sizing criteria, the performance of the on-load tube cleaning systems, and an external deaerator are discussed. After-condenser corrosion on air ejector systems is also reviewed. Some modifications to plant specifications are suggested in the light of experience gained with these units.
W84-00742

THE RIYADH WATER TRANSMISSION SYSTEM (RWTS),
Saline Water Conversion Corp., Riyadh (Saudi Arabia).
I. M. R. Jamjoom, P. Laesser, and A. H. Feizlmayr.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 241-254, 4 Fig. (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov .29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Pipelines, *Water distribution, High pressure, Al-Jubail, *Saudi Arabia, *Riyadh.

The Riyadh Water Transmission System (RWTS), one of the biggest high pressure pipeline systems of the world, was designed to transport large quantities of potable water from the Al Jubail desalination plants on Saudi Arabia East Coast to Riyadh. The main features of the RWTS are: route length Al Jubail to Riyadh (466 km); maximum system design capacity (830,000 cu m/d); double line, pipe diameter (60 in (1524 mm), pipes made of steel similar to X 52 and X 60 outside coated with polyethylene and inside lined with cement mortar); steel weight of pipes (520,000 tons); total lifting head required (2340 m, closed high pressure system operating at station discharge pressures in the range of 50 bar); 6 pumping stations with a total installed capacity of 430 MW; and capacity of Riyadh High Point Terminal (300,000 cu m).
W84-00743

DEVELOPMENT OF ENVIRONMENTAL STANDARDS FOR COMBINED DESALINATION/POWER GENERATING STATIONS IN THE ARABIAN GULF REGION,
Lockheed Missiles and Space Co., Inc., Carlsbad, CA.
D. L. Brining, W. C. Lester, W. N. Jessee, D. A. O'Leary, and S. Bourgeois.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 255-260, 2 Tab, 2 Ref. (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Dual purpose plants, *Environmental effects, *Powerplants, Arabian Gulf.

Environmental effects associated with desalination/power generation are classified into intake and discharge components. The intake component consists of entrainment and impingement problems while the discharge component comprises chemical and physical problems associated with the receiving waterbody. Each component is discussed relative to marine communities in the receiving waterbody and a methodology is presented for establishing an environmental management policy which will protect these communities.
W84-00744

EXPERIMENTS WITH DESALINATION OF ARABIAN GULF WATER,
M. El Salem.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 261-271, 6 Fig, 5 Tab, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination processes, Membranes, *Reverse osmosis, Plate-and-frame, Thin films, *Composite membranes.

With the 'plate-and-frame' reverse osmosis system and a new thin film composite membrane it has been possible to desalt very salty water (43.000 ppm). A minimum of pretreatment has been necessary because the membranes are very resistant to pH and temperature, and the flow rate in the plate-and-frame modules is very high. The raw water is pumped directly to the multi-media filter, followed by a 25-micron cartridge filter. The growth of algae and bacteria is prevented by irradiation with UV-light. After the pretreatment the water is pumped into the modules and desalted. The economy of the process is good because of the high capacity of the membranes and the small degree of pretreatment.
W84-00745

HEAT TRANSFER AND FLUID FLOW CHARACTERISTICS IN FLASH DESALINATION UNITS,
Cairo Univ., Giza (Egypt). Faculty of Engineering.
E. E. Khalil, M. M. Hilal, M. F. El-Fouly, and H. Z. El-Mogy.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 283-294, 15 Ref, 5 Fig, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Distillation, *Flash distillation.

The effects were investigated of different operating and geometrical parameters on the flashing efficiency of water in a single stage flashing chamber. This chamber used a submerged rectangular orifice as flow control area. Experiments were performed to investigate the effects of flow rate, liquid level in the flashing chamber, liquid inlet temperature, and flashing range on the flashing efficiency under various design conditions. These comprise flow with baffle placed in the flashing chamber and wire meshes placed at the orifice to increase the turbulence level. The efficiency increased with the increase of the turbulence levels, flashing range, and liquid inlet temperature; the efficiency deceased with the increase of the flow rate and liquid level in the flashing chamber. The application of numerical procedure to predict flow pattern and heat transfer in the flashing chamber is introduced as a powerful design tool.
W84-00746

GROUND WATER RESOURCES IN FAYOUM AREA, EGYPT,
Zagazig Univ. (Egypt).
B. Mabrook, F. Sweilm, and R. El Sheikh Shoheib.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 295 (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Groundwater, *Recharge, Isotope studies, Fayoum area, Egypt, Chemical analysis, Quaroom lake, Nile Valley, Cairo.

Group 3A—Saline Water Conversion

The Fayoum area is located to the west of the Nile Valley, southwest of Cairo. It is a depression of an area of about 2000 sq km oriented in NW/SE direction. The Fayoum Province is connected to the Nile Valley by an old channel. To the northwest of the Fayoum area lies Quaroon lake with a salinity of about 4%, which is close to that of seawater. As a result of geological structure of this area, about 7 springs are scattered in the area. The area gets its main fresh water supplies from Bahr Yousel Canal, however, a considerable quantity of water is supplied from groundwater recharged from the cracked and cavernous limestone. Groundwater is recharged from the Nile and not from Bahr Yousef. Local groundwater is regarded as a source for some water inflow to Bahr Yousef. The recharge pattern of the groundwater is given. The contribution of the salty water of Quaroom lake is discussed.
W84-00747

ORIGIN OF SUBSURFACE WATER IN KHARTOUM PROVINCE, SUDAN,
Zagazig Univ. (Egypt).
B. Mabrook, F. Sweilm, and R. El Sheikh Shoheib.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 297 (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: Subsurface water, *Groundwater, Aquifers, *Hydrology, Khartoum, *Sudan, Nubia sandstone, El Gazira foundation, Egypt.

The study of the groundwater resources in Khartoum Province and the possibilities of their development have led to the question of hydrochemical variation with subsurface water origin. A combination between hydrogeological conditions with chemical and isotopic analyses is given for evaluation of the water resources. The principal water bearing formation are Nubia sandstone, El Gazira formation, and the alluvial wadi deposits. The storage capacity of the different aquifers as well as annual storage change are estimated. The hydrochemical composition of the aquifers reflects the continental NaHCO sub 3 and Na sub 2 SO sub 4 water types. Subsurface water is recharged from pluvial periods and present running water. Local groundwater is regarded as a source for some water inflow to running water.
W84-00748

CLOSED CYCLE TEXTILE DYEING:FULL SCALE RENOVATION OF HOT WASH WATER BY HYPERFILTRATION,
Carre, Inc., Seneca, SC.
C. A. Brandon, D. A. Jernigan, J. L. Gaddis, and H. G. Spencer.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 301-310, 3 Fig, 2 Tab, 5 Ref. (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination processes, Membranes, *Hyperfiltration, Recycling, Textiles, *Dyes.

A full scale dynamic hyperfiltration system has been coupled to an operating dye range. The hyperfiltration system, its function in the recycle process, preliminary performance, and economic impact are described.
W84-00749

VIRGIN ISLANDS WATER AND POWER AUTHORITY (VIWAPA) HORIZONTAL TUBE, FALLING FILM, LOW TEMPERATURE 1.25 MGD MULTI-EFFECT DISTILLATION DUAL PURPOSE PLANT,
Virgin Islands Water and Power Authority, St. Thomas.
T. R. Blake, and G. Willocks.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 311-322, 3 Fig, 3 Tab, (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Distillation, Horizontal tube falling film, Multieffect distillation, *Dual purpose plants, Virgin Islands.

Three 1.25-MGD horizontal-tube, falling-film, low-temperature, multieffect distillation units commissioned. These units are described with special emphasis made on the criteria for their selection and various aspects of dual purpose operation.
W84-00750

THE CARIBBEAN, THE OTHER AREA OF CONCENTRATION OF DESALINATION PLANTS,
Fairleigh Dickinson Univ., Teaneck, NJ.
R. Bakish.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 323-334, 2 Tab, 10 Ref, 6 Fig, (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Caribbean.

From 1928 when the first land-based desalination plant was installed on the island of Curacao in the Dutch Antilles today, there are five decades of uninterrupted success for the Caribbean in the role of 'principle actor' in the play 'Better Water Supply Through Experience and Adoption of Advanced Desalination Technology'. It is almost certain that under the continued pressure of energy costs and conservatism elsewhere in the world that this location will continue to maintain its leadership in innovation. The population and industrial growth of the region will continue to fuel the growth of desalination.
W84-00751

DESALINATION IN MEXICO,
Bosques de la Herradura, Mexico City.
R. Manjarrez.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 335 (Abstract only) (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, *Organizations, Political aspects, Mexico.

For the last 20 years Mexico has been gradually installing desalination plants for a diversity of purposes. Within the Mexican government desalination activities have been promoted by two agencies. The first has been responsible for desalination in service of better quality water for power generation while in the alternate the emphasis has been in brackish and saline water conversion for community potable and consumer related water supplies. The private sector has in most instances also relied on the government agencies for satisfying of industrial needs but not to the exclusion of private industry desalination plant construction. The effectiveness of the approach utilized by the government agencies active in the field is reviewed along with the possible and potential impact of the use of desalination by the private sector.
W84-00752

REDUCING AND MONITORING CORROSION IN MSF EVAPORATORS IN THE CHANGE-OVER FROM ACID TREATMENT TO TREATMENT WITH ADDITIVES,
Nalco Italiana S.p.A., Rome (Italy).
G. F. Casini, I. S. Di Simone, and M. Minervini.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 339-350, 3 Fig, 1 Tab, 11 Ref. (2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Corrosion, *Multistage flash distillation, Evaporators, Scaling, Acid treatment, *Additives, Polymers.

A multistage flash plant operating in the Mediterranean area is discussed where seawater acid treatment was replaced by scale control through the use of a proprietory polycarboxylic synthetic polymer. Corrosion effects were monitored in the brine and in the distillate system. The results obtained make manifest the less corrosive conditi
both Copper Alloys (90/10 Cu-Ni) and
Steel during the additive treatment.
W84-00753

**STUDIES, TESTING AND DEVELOPME
A LINE OF BRINE RECIRCULATING P
FOR SEA WATER DESALINATION IN
LATIONS,**
Bergeron S.A., Paris (France).
A. Le Grand, and J. F. Lapray.
Desalination, Vol 39, Nos 1/2/3, Decembe
p 351-361, 5 Fig, 2 Ref. (2nd Vol. Proc.
Congress on Desalination and Water
Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination
Distillation, Brines, *Pumps, Materials
Corrosion, *Multistage flash distillation.

The different steps involved in design and
of brine recirculation pumps are reviewed p
larly regarding reliability against wear and
sion. The running conditions of the pumps d
on the nature of the fluid pumped and its te
ture. The large range in capacity and low
head enable the pumps to endure difficult
tions. The development program for a co
pumping range for multistage flash (MSF)
nation plants includes: design and model tes
the hydraulic part, research platform tes
checking and increase of hydraulic perfor
especially for cavitation, design of a pump
type for 6000 cu m/d MSF unit (1.6 mgd
endurance test for loop simulation in the las
of MSF. In 1980 there were 4 runs of 1000
with dismantling and examination of all parts
end of each run. Pumps were designed for
industrial plants of 10,000 and 20,000 cu m
and 6 mgd).
W84-00754

**DESALINATION AND RENEWABLE E
GIES - A FEW RECENT DEVELOPMENTS**
CEA Centre d'Etudes Nucleaires de Saclay
sur-Yvette (France).
J. J. Libert, and A. Maurel.
Desalination, Vol 39, Nos 1/2/3, p 363-372
cember 1981, 7 Fig, 2 Tab, 2 Ref. (2nd Vol.
of Int. Congress on Desalination and Water
Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Energy, *Solar e
*Wind, Thermal power, Distillation, Rever
mosis, Solar stills, Greenhouses.

The research work carried out by the 'Comm
iat a l'Energie Atomique' with respect to des
by renewable energies was oriented toward
use of solar energy, wind energy, and the th
energy of oceans. The results obtained in the
of reverse osmosis are given and associated
with a solar motor or with an aerogenerat
solar desalting greenhouse is described.
W84-00755

**COMBINED MSF/VTE-MODULES
HYBRID THERMAL SEAWATER DESAL
TION PLANTS,**
Dortmund Univ. (Germany, F.R.).
J. Hapke, and B. Uckermann.
Desalination, Vol 39, Nos 1/2/3, December
p 373-384, 6 Fig, 12 Ref. (2nd Vol. Proc. o
Congress on Desalination and Water R
Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination p
Seawater, *Multistage flash distillation, Eva
tors, Computer models, Heat exchangers.

The design of combined multistage flash/ve
tube evaporators (MSF/VTE)-modules
seawater desalination plants is described. A
puter aided model for the determination o
mass and energy balance as well as for the rati
heat exchanger surfaces was established. More
the dependence of the product portions in
MSF/VTE-parts and the specific energy req
ment on the operation and plant variables
analysed. The heating-surface-rating based the

d for design studies of standardized mod-
a MSF/VTE-plant with a capacity of 5
'56

TIES IN SPAIN,
and Wilcox Espanola S.A., Madrid
ra, J. Guzman, and R. Sterner.
tion, Vol 39, Nos 1/2/3, December 1981,
6, 3 Fig, 6 Tab, 3 Ref, (Comprising 2nd
c. of Int. Congress on Desalination and
Reuse, Manama, Nov. 29-Dec. 3, 1981).
ors: *Desalination, Desalination plants,
supply, *Water demand, Spain, Balearic
Canary Islands.
lem of water scarcity both in the peninsu-
tteranean) and in the Balearic and Canary
agos looking to the year 2000 is analyzed.
s and future demand are quantified in
d the deficit that will occur from 1981 to
stablished. It is proposed that desalination
be planned with a view to resolving this
Accomplishments to date are summarized
cipal and industrial plants as well as for
ntal or pilot plants.
57

NATION IN AUSTRALIA - PAST AND
,
Univ. (Australia).
nton, and J. P. Gerofi.
ion, Vol 39, Nos 1/2/3, December 1981,
, 6 Fig, 3 Tab, 17 Ref. (2nd Vol. Proc. of
gress on Desalination and Water Reuse,
Nov. 29-Dec. 3, 1981).
ors: *Desalination, Reverse osmosis, Dis-
Vapor compression distillation, Electro-
Australia.
its vast arid areas, Australia only has a
ll proportion of the world's installed de-
capacity. Current plants are surveyed.
the operational problems that have oc-
re outlined. Demineralisation plants are
idered. The water resources of Australia
wed, and areas delineated where desalina-
t be applicable. Within the context of the
urces available in different localities, the
applicability of various desalination tech-
s discussed.
58

ING EXPERIENCE ON RO SEA
DESALINATION PLANT AT CHIGA-
BORATORY,
e-Use Promotion Center, Tokyo (Japan).
ada, K. Ohta, H. Kaneda, M. Hirai, and Y.
a.
ion, Vol 39, Nos 1/2/3, December 1981,
, 5 Fig, 3 Ref, (2nd Vol. Proc. of Int.
on Desalination and Water Reuse,
Nov. 29-Dec. 3, 1981).
ors: *Desalination, Desalination plants,
osmosis, *Membranes, Chigasaki,
fiber modules, Spiral wound modules,
stration plant with a capacity of 800 cu
been operating satisfactorily in Chigasaki
ry since September 11, 1979. The plant
sets of modules, namely hollow fiber and
und types. These two types of modules
operated alternately every other month,
plied sea water from the same pretreat-
ility and the same high pressure pump.
mulated operation time of each module
eded 5,000 hours. The operation result
gh recovery ratio, low energy consump-
good quality of product water.
59

ZATION OF INTEGRATED COGEN-
N POWER PLANT AND DESALINA-
LANT SYSTEMS FOR A RANGE OF

POWER AND WATER SUPPLY REQUIREMENTS,
Gibbs and Hill, Inc., New York.
L. F. Giannuzzi, O. E. Horn, and M. Nakhamkin.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 437-446, 7 Fig, (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, *Economic evaluation, Optimization.

Comparative economic analysis is presented which shows necessity of integrated power and desalination plants optimization rather than separate optimization of power generating and desalination units. This analyses introduces: (1) calculational procedure and resulting curves for cogeneration plant selection for a range of power and steam demands; (2) conceptual procedure for integrated power plant and desalination plant system optimization; and (3) Results of comparative economic analysis of integrated power desalination plant optimization as compared with separate power plant and desalination plant optimization.
W84-00761

THE APPLICATION OF PELTON TYPE IMPULSE TURBINES FOR ENERGY RECOVERY ON SEA WATER REVERSE OSMOSIS SYSTEMS,
Hayward-Tyler Pump Co., Burlington, VT.
D. J. Woodcock, and I. M. White.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 447-458, 7 Fig. (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination apparatus, Reverse osmosis, Seawater, Energy recovery, Costs, *Turbines.

Impulse turbine technology is well-established and readily adaptable to energy recovery systems for seawater reverse osmosis. The broad operating range and standardized package approach allows a high level of design engineering availability and flexibility for standard plant sizes from 30,000 GPD to 3 MGPD. The high-efficiency, simple design and operating requirements of impulse turbines, makes them particularly attractive for energy recovery systems. Reductions of approximately 45% in required energy can result in significant energy savings and improve the competitive price for fresh water produced from seawater reverse osmosis. As the world requirement for fresh water grows, combined with the demand for conservation of oil and the increase in energy cost, the attraction toward impulse turbine energy recovery systems will similarly grow over a wider range of economic conditions and plant sizes.
W84-00762

AN INTEGRATED SELF SUFFICIENT MULTIPURPOSE PLANT FOR SEAWATER DESALINATION,
Kraftwerk Union A.G., Erlangen (Germany, F.R.).
K. Kuenstle, and G. Brunner.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 459-474, 5 Fig, 1 Tab, 2 Ref. (Comrising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, Desalination plants, Seawater, *Multistage flash/vertical tube evaporator, Drinking water, Chemical potential.

A multipurpose plant is described, which produces drinking water and chemicals from seawater. The most important part of the plant consists in a combined multistage flash/vertical tube evaporator, which operates on a high economy ratio and enables also a high concentration of the brine. These two facts are due to a special treatment of the evaporator feedwater by chemical agents produced from the concentrated brine. A surplus of these chemicals can be sold. The energy supply of the complex is assured by an adequate power station, which provides process steam and electricity at such a ratio as to minimize fuel cost.
W84-00763

EDUCATION AND TRAINING IN DESALINATION AROUND THE WORLD,
Fairleigh Dickinson Univ., Teaneck, NJ.
R. Bakish.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 477-482, 4 Ref. (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, *Education, *Training, Desalination plants.

The need for education and training remains as great as ten years ago, and in principle all that is needed is a change of attitude. The problem then, as it is now, is the fact that those who need the trained personnel must realize that the need is real. Once this is accomplished, they must add the cost of training to the plant costs and be prepared to cover them. It appears that perhaps the most difficult task is that of educating plant management to the need for trained operators.
W84-00764

A NEW IDEA FOR TRAINING OPERATORS,
A. De Maio, F. Fioravanti, and G. Odone.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 483-487, 1 Fig, 4 Ref. (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: Desalination, *Desalination plants, *Training.

Experience in training personnel in desalination plant operation is described.
W84-00765

HANDLING OF FUZZY DECISIONS IN THE ENGINEERING MANAGEMENT OF LARGE DESALINATION PLANTS,
Riyadh Univ. (Saudi Arabia). Coll. of Engineering.
A-R. F. Abdul-Fattah.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 489-490 (Abstract only) (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: Desalination, *Desalination plants, *Management planning, Fuzzy set theory.

Engineering managers of large desalination projects often face several alternate strategies, the choice among which is rather unclear due to the lack of specific statistics to favor one choice over the others. Usually, the manager eliminates some options in a preliminary screening process, thus ending with a limited but viable alternative, each of which has its own merits. Fuzzy set theory provides a practicable tool in cases of management decisions under uncertainty where the factors affecting the decision are imprecise in nature. Fuzzy decision-making utilizes the set theory to provide ranges representing subjective judgements in absence of precise quantitative measures. The approach has been formalized in an interactive computer code which can be easily used by managers without the need for familiarization with the theoretical foundations of set theory.
W84-00766

A TAILORED PROCESS FOR REMINERALIZATION AND POTABILIZATION OF DESALINATED WATER,
Italconsult, Rome (Italy).
E. Gabbrielli.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 503-520, 1 Fig, 4 Tab, 20 Ref. (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Desalination, *Water treatment, *Potable water, Drinking water, Mineralization, Remineralization, Potabilization.

Economic analysis of feasible remineralization and potabilization policies for desalination water emphasizes the desirability of a process producing fresh water which is of high quality in every respect (health, stability, palatability, etc.). In fact

the cost of such a process is only a fraction of that required for actual desalination (7.5% in the reported case). A complete remineralization and potabilization process is discussed particularly suited for desalinated water with relatively low residual TDS. The process is based on the use of natural carbonate rocks and CO sub 2, and enables all the basic stability parameters of the fresh water produced to be adjusted to the desired values, even in the presence of relatively large quantities of chlorides (100-200 ppm) and fairly high final TDS (400-500 ppm); at the same time purchase of large quantities of manufactured salts is avoided. The critical steps in designing such a plant are outlined and a comparative assessment is made of the capital and running costs of the suggested process and of another using manufactured salts such as CaCl sub 2 and NaHCO sub 3. The remineralization and potabilization unit is increasingly becoming a specialized part of the desalting plant, the design of which calls for specific know-how.
W84-00768

3B. Water Yield Improvement

WATER INFORMATION FOR NORTHWESTERN MISSOURI--A PLANNING DOCUMENT,
Geological Survey, Rolla, MO. Water Resources Div.
J. Skelton, E. J. Harvey, and D. E. Miller.
USGS Water Resources Investigation, 1982. 58 p, 7 Fig, 12 Tab, 22 Ref.

Descriptors: Water resources planning, *Potential water supply, *Glacial drift, *Alluvium, *Low flow, *Missouri, Population growth rates, Water quality, Water use, Gaging stations, Missouri River, *Streamflow statistics, Coal gasification, Pennsylvanian bedrock.

Water supplies are limited in much of northwestern Missouri, and water-resources data are also limited. The report presents a summary of hydrologic data and an evaluation of areas where future hydrologic investigations would be most useful. The largest and most dependable surface-water supplies that can be obtained without storage from tributary streams are from the lower Grand, Nodaway, and Chariton Rivers. The sources of ground water in order of quantities available are the Missouri River alluvium, glacial drift, tributary stream alluvium, and Pennsylvanian bedrock. Irrigation and industry are concentrated along the Missouri River where alluvial ground water is abundant. (USGS)
W84-00810

3C. Use Of Water Of Impaired Quality

WATER QUALITY OF COAL DEPOSITS AND ABANDONED MINES, SAGINAW COUNTY, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00926

3D. Conservation In Domestic and Municipal Use

EVALUATING THE EFFECTIVENESS OF PROMOTING RESIDENTIAL WATER CONSERVATION THROUGH EXHIBITS,
Virginia Water Resources Research Center, Blacksburg
K. P. Sevebeck, and W. R. Walker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140565, Price codes: A10 in paper copy, A01 in microfiche. Completion Report, August 1983. 254 p, 30 Ref, 18 Append. OWRT C-10048-C and T(No 1448)(1), 14-34-0001-1448.

Descriptors: *Water conservation, *Conservation, *Domestic water conservation, *Education, Computer programs, *Exhibits, Computers, Domestic water, Water quality, Water quantity, Water use, Technology transfer.

This report describes how the Virginia Water Resources Research Center designed, constructed, implemented, and evaluated an exhibit program on residential water conservation. The report contains detailed information on the components of five exhibits and includes specific information on fabricating audio-visual displays, visitor participatory units, computer programs, and written educational materials to promote residential water conservation. Appendices list sources for equipment; describe computer programs; present construction drawings and exhibit photographs; and give sample evaluation and interview questionnaires, promotional materials, and three publications. Evaluation of the exhibit program showed that an exhibit is an effective medium for promoting residential water conservation and for changing citizen attitudes about water resources.
W84-00963

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1980-NOVEMBER 30, 1981,
Geological Survey, Milford, PA. Water Resources Div.
F. T. Schaefer, and R. E. Fish.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $14.25 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-341, 1982. 115 p, 9 Fig, 20 Tab.

Descriptors: *Delaware River, *Diversion release, Water management, *Drought, Water quality, Water supply, Salt water intrusion, Reservoir yield, *Regulation, Supply, Interbasin transfers.

Water supply conditions at the beginning of the year were marginal in marked contrast to those for the preceeding nine years. Discharge of the Delaware River at Montague, New Jersey, was only 72% of median as compared to 68% in excess of median the previous year. In December, with reservoir storage again declining, further reductions in both diversions and releases were imposed. With consent of all the parties, reductions were effected on December 20 limiting New York City diversions to 560 mgd, New Jersey to 65 mgd, and the required discharge at Montague was targeted at 1550 cfs. To conserve supplies, additional reductions were imposed in January when the Delaware River basin Commission formally declared a drought. New York City's limitations was set at 520 mgd and that for New Jersey at 62 mgd. Montague flows were targeted between 1100 cfs, depending upon the location of the salt front in the estuary. Water quality of the Delaware River and Estuary was monitored on a continuous basis at eight sites for most of the year and on a monthly basis at ten sites to accurately locate the salt front. Highest concentrations observed at the Benjamin Franklin Bridge site was 133 mg/l (milligram per liter) on February 2. (USGS)
W84-01040

3E. Conservation In Industry

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1980-NOVEMBER 30, 1981,
Geological Survey, Milford, PA. Water Resources Div.
For primary bibliographic entry see Field 3D.
W84-01040

4. WATER QUANTITY MANAGEMENT AND CONTROL

4B. Groundwater Management

GEOHYDROLOGIC RECONNAISSANCE OF DRAINAGE WELLS IN FLORIDA--AN INTERIM REPORT,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. O. Kimrey, and L. D. Fayard.
Available from the OFSS, USGS Lakewood, CO 80225, Price: $8.00 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-860, 1982. 14 Fig, 6 Tab, 41 Ref.

Descriptors: *Drainage wells, *Injection wells, *Artificial recharge, *Groundwater pollution, Underground storage, Carbonate aquifers, *Florida, Statewide reconnaissance.

Drainage wells are used to inject surface water directly into an aquifer, or shallow groundwater directly into a deeper aquifer, primarily by gravity. Such wells in Florida may be grouped into two broad types: (1) Surface-water injection wells, and (2) interaquifer connector wells. Surface-water injection wells are commonly used to supplement drainage for urban areas in karst terranes of central and north Florida. Data are available for 2 wells in the Ocala, Live Oak, and Orlando areas to allow comparison of the quality of water injected from these Floridan aquifer drainage wells with allowable contaminant levels. Comparison indicates that maximum contaminant levels for turbidity, color, and iron, manganese, and lead concentrations are equaled or exceeded in some drainage well samples, and relatively high counts for coliform bacteria are present in most wells. Interaquifer connector wells are used in the phosphate mining areas of Polk and Hillsborough County to drain mining operations and recharge the Floridan aquifer. Water-quality data available from interconnector wells indicate that samples from most of these wells exceed standards values for iron concentration and turbidity. One well yielded a highly mineralized water, and samples from 6 of the 12 wells exceed standards values for gross beta concentrations. (USGS)
W84-00865

LAND SUBSIDENCE IN THE SAN JOAQUIN VALLEY, CALIFORNIA, AS OF 1980,
Geological Survey, Sacramento, CA. Water Resources Div.
R. L. Ireland, J. F. Poland, and F. S. Riley.
Available from the OFSS, USGS Lakewood, CO 80225, Price: $18.25 in paper copy, $4.50 in microfiche. USGS Open-File Report 82-370, June 1984. 129 p, 70 Fig, 6 Tab, 55 Ref.

Descriptors: *Subsidence, *Extensometers, *Groundwater, *Confined aquifer, *Unconfined aquifer, *California, San Joaquin Valley, Los Banos-Kettleman City Area, Tulare-Wasco Area, Arvin-Maricopa Area.

Land subsidence due to ground-water overdraft in the San Joaquin Valley began in the mid-1920's and continued at alarming rates until surface water imported through major canals and aqueducts in the 1950's and late 1960's. In areas where surface water replaced withdrawal of ground-water, water levels in the confined system rose sharply and subsidence slowed. In the late 1960's and early 1970's water levels in wells recovered to levels of the 1940's and 1950's throughout most of the northern and southern parts of the Valley, in response to the importation of surface water through the California aqueduct. During the 1976-77 drought, data collected at water-level and extensometer sites showed the effect of heavy demand on the groundwater resevoir. With the 'water of compaction' gone, artesian head declined 10 to 20 times as much as during the first cycle of long-term drawdown that ended in the late 1960's. In the 1978-79 water levels recovered to or above the 1976 pre-drought levels. The report suggests continued monitoring of land subsidence in the San Joaquin Valley. (USGS)
W84-00932

GROUNDWATER MANAGEMENT IN THE SOUTHEAST,
North Carolina State Univ. at Raleigh.
D. H. Howells, and J. C. Warman.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No W

October, 1982. 5 Ref. OWRT B-123-NC
5-NC.

ors: *Groundwater management, *State
on, Symposium, Groundwater pollution,
pects, Legislation, Research priorities, Ad-
ion, Conjunctive use, Well regulations, In-
l constraints, Information exchange,
pply, *Southeast U.S.

er summarizes and critiques groundwater
ent programs in the southeastern (U.S.)
presented in papers at the Southeast Con-
on Groundwater Management, Birming-
abama, January 30-31, 1980. Legal and
rative issues, groundwater pollution, and
l diversity are discussed. Groundwater
n is handled on a statewise basis in Geor-
gional basis in Florida, and a capacity use
tably unsuccessful) in Mississippi, North
South Carolina, and Virginia, and is not
in Alabama and Tennessee. Organiza-
rangements for administration of programs
dely, from shared responsibility among
to an all-state authority and regional man-
districts. Groundwater characterization
re more advanced in the coastal region
ne Piedmont and mountain areas. Alabama
nprehensive program to minimize ground-
ntamination from waste disposal oper-
North Carolina and Florida are the only
the Southeast with groundwater quality
ion systems. Conjunctive management of
vater and groundwater has received little
to date in the Southeast. Natural ground-
oblems include excessive fluoride concen-
ardness, radium and radon, corrosivity,
on and sulfates, and taste and odor prob-
e most common man-made water quality
are caused by poorly located septic
ells transmitting surface flows to the
nd industrial waste disposal. Recommen-
or needed legislation, institutional agree-
nding, research, data transfer, and educa-
isted. (Cassar-FRC)
55

**CONOMIC VALUE OF GROUND
RECHARGE FOR IRRIGATION USE,**
Univ.-Lincoln. Dept. of Agricultural
cs.
alla, and D. A. Comer.
esources Bulletin, Vol 18, No 4, p 679-686,
1982. 1 Tab, 19 Ref. OWRT A-065-NEB.

ors: *Water supply, *Model studies,
esources development, Irrigation, Finan-
cts, *Aquifer recharge, Aquifers, Ground-
mping, Artificial recharge, Groundwater
ent, *Nebraska.

dology was sought for estimating ground
charge benefits in irrigation use areas, and
hodology was used to estimate ground
charge benefits for selected situations.
jectives were addressed using a Nebraska
presented, the methodology separates re-
enefits into two components: pumping
ings and aquifer extension benefits. Simpli-
edures designed for use by state and fed-
r planning agencies are presented for each
benefits component. Experience indicates
required data, time, and computer re-
or the model were within the range which
ermit use of the model for first round,
ssance level studies as well as for more
ensive analyses. Results of recharge bene-
ations indicate that benefits in irrigation
probably range from less than $2.00 to
0 an acre foot. A comparison to published
recharge costs concludes that single pur-
arge programs to augment water supplies
tion are certainly economically unfeasible.
, the analysis indicates that the benefits of
are probably substantial enough to merit
sideration as part of appropriate multipur-
er projects. (Baker-FRC)
57

**GINEERING ECONOMIC ANALYSIS
IFICIAL RECHARGE IN A CONJUNC-
TIVE IRRIGATION PLAN IN THE COLUMBIA BASIN PROJECT, WASHINGTON,**
Geological Survey, Tacoma, WA. Water Resources Div.
M. R. Karlinger, and A. J. Hansen, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-196022, Price codes: A03 in paper copy, A01 in microfiche. USGS Open-File Report 81-67, 1983. 28 p, 6 Fig, 7 Tab, 6 Ref.

Descriptors: *Artificial recharge, *Irrigation practices, Irrigation wells, Surface irrigation, Economic feasibility, *Columbia Basin Project, *Washington, *Conjunctive use.

An appraisal-level engineering economic cost analysis was performed for two primary types of irrigation systems in a portion of the Columbia Basin Project- a surface-water irrigation system in which water is supplied via canals and laterals, and a system in which surface water is brought to recharging wells and eventually to farms using the transmissive properties of the aquifer and pumping. At 1979 electric power rates, the artificial-recharge irrigation scheme is a viable alternative to surface-distributed irrigation systems, but as electric rates increase, its viability decreases. At three times the 1979 rate, the recharge scheme is uneconomical. (USGS)
W84-00989

NUMERICAL SIMULATION OF GROUNDWATER FLOW IN THE LOWER SATUS CREEK BASIN, YAKIMA INDIAN RESERVATION, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
E. A. Prych.
USGS Water Resources Investigations Report 82-4065, 1983. 78 p, 30 Fig, 17 Tab, 16 Ref.

Descriptors: *Groundwater, *Computer models, Waterlogging, Groundwater basins, Groundwater management, Canal seepage, Drawdown, *Geohydrology, Satus Creek, Lower Satus Creek basin, *Washington, Yakima Indian Reservation.

A multilayer numerical model of steady-state ground-water flow in lower Satus Creek basin was constructed, calibrated using time-averaged data, and used to estimate the long-term effects of proposed irrigation-water management plans on ground-water levels in the area. Model computations showed that irrigation of new lands in the Satus uplands would raise ground-water levels in lower Satus Creek basin and thereby increase the size of the waterlogged areas. The model also demonstrated that pumping water from wells, reducing the amount of irrigation water used in the lowlands, and stopping leakage from Satus No. 2 and 3 Pump Canals were all effective methods to alleviate present waterlogging in some parts of the basin and to counteract some of the anticipated ground-water-level rises that would be caused by irrigating the uplands. The proposed changes in water use affected model-computed ground-water levels most in the eastern part of the basin between Satus No. 2 and No. 3 Pump Canals. The effects on ground-water levels in the western part of the basin between Satus Creek and Satus No. 2 Pump Canal were smaller. (USGS)
W84-01010

4C. Effects On Water Of Man's Non-Water Activities

MODEL MODIFICATIONS FOR SIMULATION OF FLOW THROUGH STRATIFIED ROCKS IN EASTERN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
J. O. Helgesen, S. P. Larson, and A. C. Razem.
USGS Water-Resources Investigations 82-4019, 1982. 109 p, 6 Fig, 6 Ref.

Descriptors: *Computer models, Perched groundwater, *Groundwater flow, Perched springs, Surface-groundwater relations, *Ohio, Computer programs, Three dimensional flow.

A quasi three-dimensional groundwater flow model is being used as part of a study to determine impacts of coal-strip mining on local hydrologic systems. Modifications to the model were necessary to simulate local hydrologic conditions properly. Perched water tables required that the method of calculating vertical flow rate be changed. A head-dependent spring-discharge function and a head-dependent stream aquifer-interchange function were added to the program. Modifications were also made to allow recharge from precipitation to any layer. The modified program, data deck instructions, and sample input and output are presented. (USGS)
W84-00773

EFFECT OF URBANIZATION ON THE WATER RESOURCES OF WARMINSTER TOWNSHIP, BUCKS COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-00774

PROCEDURES FOR ASSESSMENT OF CUMULATIVE IMPACTS OF COAL MINING ON THE HYDROLOGIC BALANCE,
Geological Survey, Reston, VA. Water Resources Div.
A. M. Lumb.
Available from the OFSS, USGS, Lakewood, CO 80225, Paper copy $7.25, Microfiche $3.50. USGS Open-File Report 82-334, 1982. 50 p, 12 Fig, 10 Tab, 44 Ref.

Descriptors: *Mine drainage, *Environmental effects, *Simulation analysis, Hydrologic models, Hydrologic budget, Cumulative impacts, Hydrologic consequences.

Techniques were developed to assess the probable cumulative impacts of anticipated surface mining upon the hydrology of and area. An activity profile of cumulative drainage area versus river miles downstream from the surface mining site is constructed that shows major water uses, flood prone areas, and stream classifications. From the summary shown by the activity profile, an impact matrix is used as a checklist for the importance of the impacts under categories such as water supply, flood prone areas, water contact recreation, etc. Based on the categories checked on the impact matrix, a simple, less accurate model or a more comprehensive and accurate one can be used to quantify the impacts. Quantified impacts are then displayed on an impact profile showing the percentage change in a hydrologic characteristic versus distance downstream of the surface mining site. The simple model for quantification considers only dilution from tributary areas during critical periods whereas the comprehensive model routes flows and quality of water continuously through the year and considers, in addition to dilution, instream processes such as settling, biological uptake, and chemical reactions. (USGS)
W84-00780

EFFECTS OF URBANIZATION ON THE MAGNITUDE AND FREQUENCY OF FLOODS ON SMALL STREAMS IN TENNESSEE-BASIC DATA REPORT NO. 2,
Geological Survey, Nashville, TN. Water Resources Div.
C. H. Robbins.
Available from the OFSS, USGS, Lakewood, CO 80225; Price: $3.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-911, 1982. 25 p, 1 Fig.

Descriptors: *Floods, *Small watersheds, *Hydrologic data, Peak discharge, Gaging stations, Flood peaks, Basin characteristics, *Tennessee.

Peak stages, discharges, and rainfall recorded at 22 gaging stations on streams draining small (less than 25 mi super 2) urbanized basins across Tennessee

are presented. The gaged basins are in 17 different municipalities with populations ranging between 5,000 and 100,000. The report gives a description of each gaged site along with a data sheet on which peak stages, discharges, and corresponding rainfall are listed. The description gives the station location, type of gage, basin characteristics, and general remarks. (USGS)
W84-00826

CANE CREEK FLOOD-FLOW CHARACTERISTICS AT STATE ROUTE 30 NEAR SPENCER, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
C. R. Gamble.
USGS Open-File Report 83-267, 1983. 12 p, 4 Fig, 1 Tab, 5 Ref.

5

Descriptors: *Floods, *Flood profiles, High water mark, Step-backwater routing, Flow through bridges, *Tennessee, Spencer.

The Tennessee Department of Transportation has constructed a new bridge and approaches on State Route 30 over Cane Creek near Spencer, Tennessee. The old bridge and its approaches were fairly low, permitting considerable flow over the road during high floods. The new bridge and its approaches are considerably higher, causing different flow conditions at the site. Analysis of the effects of the new bridge, as compared to the old bridge, on floods of the magnitude of the May 27, 1973, flood is presented. The May 27, 1973, flood was greater than a 100-year flood. Analysis of the 50- and 100-year floods for the new bridge are also presented. Results of the study indicate that the new construction will increase the water-surface elevation for a flood equal to the May 27, 1973, flood by approximately 1 foot upstream from bridge. (USGS)
W84-00871

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE COOK CREEK AREA, ASHLAND COAL FIELD, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
M. R. Cannon.
Available from the USGS, OFSS, Federal Center, Lakewood, CO 80225, Paper copy $8.0, Microfiche $4.50. USGS Open-File Report 82-681, August 1982. 30 p, 7 Fig, 3 Tab, 28 Ref.

Descriptors: Hydrology, *Coal mines, *Reclamation, *Water quality, *Montana, Cook Creek, Powder River Basin, *Hydrologic data, *Shallow aquifers, Groundwater.

The Cook Creek area of the Ashland coal field contains large reserves of Federally owned coal that have been identified for potential lease sale. A hydrologic study has been conducted in the potential lease area to describe existing hydrologic systems and to assess potential impacts of surface coal mining on local water resources. Hydrogeologic data collected from wells, springs, and drill holes indicate that shallow aquifers exist within the Tongue River Member of the Fort Union Formation (Paleocene age) and within valley alluvium (Pleistocene and Holocene age). Shallow aquifers within the Tonge River Member include coal beds, clinker, and lenses of sandstone and siltstone. The Knobloch coal bed, a principal shallow aquifer used for livestock watering in the area, averages about 55 feet in thickness and is completely saturated throughout most of its extent. Coarse alluvial deposits are the most productive aquifers and are a major source of stock water in the Cook Creek basin. Surface-water resources are limited to the upstream reach part of Cook Creek, which flows intermittently. The downstream reach part of Cook Creek, plus all other small drainages that originate in the study area, are ephemeral. Mining of the Knoblock and Sawyer coal beds would remove two alluvial springs, one bedrock spring, and two wells, which are all used for watering of livestock. The potentiometric surface within the Knobloch coal aquifer and the alluvial aquifer in the downstream part of the Cook Creek basin would be lowered during mining. Lowered water levels in these aquifers might substantially affect water levels in five wells outside the mine boundary. After mining, the alluvial aquifer downgradient from the mine area might show a long-term degradation in water quality as a result of leaching of soluble salts from overburden materials used to backfill mine pits. Although mining would alter the existing hydrologic systems and remove several springs and shallow wells, alternative groundwater supplies are available that could be developed to replace those lost by mining. (USGS)
W84-00899

PREMINING HYDROLOGY OF THE LIGNITE AREA IN SOUTHEASTERN DE SOTO PARISH, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
J. L. Snider.
Louisiana Department of Transportation and Development, Baton Rouge, Water Resources Technical Report No 29, 1982. 40 p, 11 Fig, 4 Tab, 28 Ref.

Descriptors: *Dewatering, *Groundwater level, *Impaired water quality, *Saline-water intrusion, Sediment basins, *Strip-mine wastes, *Suspended sediments, Coal mining, Groundwater movement, Groundwater recharge, Intermittent streams, Transmissivity, Unconfined aquifers, Water-level fluctuations, Aquifer restoration, De Soto Parish, *Louisiana, Chemard Lake lignite, Dolet Hills aquifer, Low-sulfur lignite, Fault zone, Sand-clay mixing, Sand-grain packing.

Surface mining of the Chemard Lake lignite will affect the ground- and surface-water hydrology in southeastern De Soto Parish, Louisiana. The mining will involve dewatering and removing the Dolet Hills aquifer, which overlies the lignite. This will interrupt local recharge to the aquifer and cause water-level decline near the mined area. After an area is mined the pit will be filled with spoil. The sand from the Dolet Hills aquifer may be implaced without being mixed with clay from the overburden. Under these conditions, the transmissivity of the replaced spoil may be higher initially than that of the original aquifer because of loose packing. In the event that sand and clay in the spoil are intermixed, water movement could be retarded. The major effects on water in streams draining disturbed land would be increased mineralization and increase in sediment load. Mining operators can minimize these problems by storing and treating mine drainage in sediment ponds. (USGS)
W84-01006

IMPACT OF CHANGES IN LAND USE ON THE GROUND-WATER SYSTEM IN THE SEQUIM-DUNGENESS PENINSULA, CLALLAM COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
B. W. Drost.
USGS Water-Resources Investigations Report 83-4094, 1983. 61 p, 29 Fig, 9 Tab, 22 Ref.

Descriptors: Hydrologic budget, *Groundwater recharge, *Aquifer characteristics, Saline water encroachment, Low flow, *Water quality, Clallam County, *Washington, Dungeness River.

A digital-computer model was developed to simulate three-dimensional ground-water flow in aquifers underlying the Sequim-Dungeness peninsula, Clallam County, Washington. Analysis using the model shows that leakage from irrigation ditches is the area's most important source of ground-water recharge. Termination of the irrigation system would lead to lower heads throughout the ground-water system. After 10-20 years of no irrigation, the water-table aquifer would have average drawdowns of about 20 feet and some areas would become completely unsaturated. Several hundred wells could be in danger of going dry. If irrigation were terminated, leakage from the Dungeness River would become the major source of ground-water recharge. As of June 1980, ground-water quality has apparently not been affected in the study area by the use
domestic sewage-disposal systems. The
trate-plus-nitrite (as N) concentration in
table aquifer was 0.25 milligrams per lite
maximum concentration was 2.5 millig
liter. (USGS)
W84-01014

**GROUND WATER-SURFACE WATE
TIONSHIPS IN THE BONAPARTE
BASIN, OKANOGAN COUNTY, W
TON 1979-80,**
Geological Survey, Tacoma, WA. W
sources Div.
For primary bibliographic entry see Field
W84-01017

**CHANGES IN FLOOD RESPONSE
RED RIVER OF THE NORTH BASIN,
DAKOTA-MINNESOTA,**
Geological Survey, Bismarck, ND. W
sources Div.
J. E. Miller, and D. L. Frink.
Available from the OFSS, USGS, Lakev
80225; Paper copy $21.50, Microfiche $3.
Open-File Report, August, 1982. 158 p,
Tab, 66 Ref.

Descriptors: *Flooding, *Land drainag
use, River basins, Streamflow, Strean
River of the North, Runoff processes, H
analysis, *North Dakota, Minnesota.

The magnitude and frequency of large fl
have occurred in recent years in the R
basin have caused concern that land-use
and manmade drainage have increased
This study was undertaken to determi
changes in flood response of the Red Ri
can be documented. A review of the h
setting, previous floods, flood control
and probable effects of land-use chang
that the flooding problems of the Red Ri
is complex hydrologically, highly variabl
cally, and follows a regional pattern. Th
change in flood response of the basin is d
identify. The flood-frequency, regression
ized-hydrograph, and double-mass analy
little indication of significant change in
sponse of the Red River basin at locatio
main stem. However, the large variation
discharges may mask or dwarf small ch
response of the basin. (USGS)
W84-01020

**RESERVOIR-DEVELOPMENT IMPA
SURFACE-WATER QUANTITY AND Q
IN THE YAMPA RIVER BASIN, COL
AND WYOMING,**
Geological Survey, Lakewood, CO. W
sources Div.
D. B. Adams, D. P. Bauer, R. H. Dale, an
Steele.
Available from the National Technical Inf
Service, Springfield, VA 22161 as PB8
Price codes: A06 in paper copy, A01 in mi
USGS Water-Resources Investigations R
30, 1983. 98 p, 51 Fig, 14 Tab, 49 Ref.

Descriptors: *Colorado, *Computer
Model studies, *Reservoir storage,
Energy budget, Temperature, Diversion
sion losses, *Wyoming, Yampa River bas
ematical models, Reservoir operation,
purpose reservoirs, Irrigation water, Wate
Heat budget, Stratification, Heat transfe
tion practices, Water management, Wate
tion, Consumptive use, Diversion-loss retu

Development of coal resources and a
economy is accelerating in the Yampa Ri
in northwestern Colorado and south-cent
ming. Increased use of the water resourc
area will have a direct impact on their qua
quality. As part of 18 surface-water pro
reservoirs have been proposed with a c
total storage of 2.18 million acre-feet, 419
than the mean annual outflow from th
Three computer models were used to der
methods of evaluating future impacts of

nent in the Yampa River basin. Four dif-
servoir configurations were used to simu-
effects of different degrees of proposed
development. A multireservoir-flow
cluded both within-basin and transmoun-
rsions. Simulations indicated that in many
ersion amounts would not be available for
pe of diversion. A corresponding frequen-
sis of reservoir storage levels indicated
t reservoirs would be operating with small
ges of total capacities and generally with
20% of conservation-pool volumes. Simu-
sing a dissolved-solids model indicated
ensive reservoir development could in-
verage annual concentrations at most loca-
mulations using a single-reservoir model
l no significant occurrence of water-tem-
stratification in most reservoirs due to
eservoir storage. (USGS)
042

Watershed Protection

**MFLOW AND SUSPENDED-SEDI-
TRANSPORT IN GARVIN BROOK,
A COUNTY, SOUTHEASTERN MIN-
A HYDROLOGIC DATA FOR 1982,**
cal Survey, St. Paul, MN. Water Re-
Div.
mary bibliographic entry see Field 2J.
332

**-QUALITY AND FLUVIAL-SEDIMENT
CTERISTICS OF SELECTED STREAMS
THEAST KANSAS,**
cal Survey, Lawrence, KS. Water Re-
Div.
mary bibliographic entry see Field 2J.
045

ATER QUALITY
ANAGEMENT AND
OTECTION

dentification Of Pollutants

**ICE IN WATER QUALITY MONITOR-
ND THE USE OF FIREFLY LUCIFER-
UCIFERASE ATP BIOASSAY,**
Applications, Inc., La Jolla, CA.
mary bibliographic entry see Field 5D.
769

**MINATION OF ULTIMATE CARBONA-
BOD AND THE SPECIFIC RATE CON-
(K SUB 1),**
cal Survey, Urbana, IL. Water Resources

amer, J. P. Bennett, and S. W. McKenzie.
Open-File Report 82-645, 1983. 21 p, 7 Fig,
Ref.

tors: *Oxygen demand, *Biochemical
demand, Dissolved oxygen, *Wastewater
nt, *Time-series analysis, Pollutant identifi-
*Ultimate biochemical oxygen demand,
naceous biochemical oxygen demand,
cal nitrifying inhibitors, Rate of carbona-
oxygen demand, First-stage biochemical
demand.

e carbonaceous biochemical oxygen
and the specific rate constant at which the
is exerted are important parameters in
g biological wastewater-treatment plants
assessing the impact of wastewater in re-
streams. An analytical method is presented
ses time-series concentrations of biochemi-
gen demand, defined as the calculated sum
lved oxygen losses at each time of measure-
or determining the two parameters. Two-
neasurements of dissolved oxygen are ob-
rom a water sample that is incubated in
s at 20 degrees Celsius in the presence of
in, a chemical nitrification inhibitor. Time-
concentrations of biochemical oxygen
demand that approximate first order kinetics can be analyzed graphically or mathematically to compute the two parameters. (USGS)
W84-00805

QUALITY ASSURANCE PRACTICES FOR THE CHEMICAL AND PHYSICAL ANALYSES OF WATER AND FLUVIAL SEDIMENTS,
Geological Survey, Lakewood, CO.
L. C. Friedman, and D. E. Erdmann.
Available from the Eastern Distribution Br. USGS, 604 S. Pickett St. Alexandria, VA 22304. USGS Techniques of Water-Resources Investigations, Book 5, Laboratory Analysis, Chapter A6, 1982. 181 p, 35 Fig, 40 Tab, 71 Ref.

Descriptors: *Quality control, Statistical methods, Evaluation, *Analytical techniques, *Instrumentation, Test procedures, Documentation, Data collection, Measurement, *Water analysis, Reliability, Water quality control, Data storage and retrieval, Chemical analysis, Biological properties, Materials testing, Charts, Sampling.

This manual contains practices used by the U.S. Geological Survey to assure the quality of analytical data for water, fluvial sediment, and aquatic organisms. These practices are directed primarily toward personnel making water-quality measurement. Some detail specific quality control techniques, others document quality assurance procedures being used by the Central Laboratories System of the U.S. Geological Survey and still others describe various statistical techniques and give examples of their use in evaluating and assuring the quality of analytical data. The practices are arranged into eight sections: Analytical Methods Development Procedures; Standard Quantitative Analysis Techniques; Instrumental Techniques; Reference Material; Laboratory Quality Control; Quality Assurance Monitoring; Documentation, Summary, and Evaluation of Data; and Materials Evaluation. Each section is preceded by a brief description of the material covered. Similarly within each section, each practice is preceded by a description of its application or scope. (USGS)
W84-00812

ANALYSIS OF WATER SAMPLES FOR TOXIC VOLATILE ORGANIC COMPOUNDS: STATE OF THE ART METHODS AND STRATEGIES FOR SAMPLING,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
G. A. Eiceman.
Proceedings of Twenty-eighth Annual New Mexico Conference, 'Water Quality in New Mexico,' April 5-6, 1983. WRRI Report No 169, New Mexico Water Resources Research Institute, Las Cruces, June 1983. p 170-185, 6 Fig, 12 Ref.

Descriptors: *Volatile solids, *Chemical wastes, *Vapor pressure, *Gas chromatography, *Toxicity, *Hazardous wastes, *Poisons, *Surveys, Chromatography, Water sampling, Testing procedures, Water resources institutes, Water quality standards, Rivers.

Rapid development of advanced analytical methods for determining toxic volatile organic compounds (VOC) in water coincided with their discovery in river and drinking water, however, evidence of interest in this subject dates from the early 1950s. Methods of analysis of water for VOC were refined throughout the 1970s so that today rapid analysis of aqueous samples for complex mixtures of VOC at parts per billion concentration ranges are relatively rapid and inexpensive. There were three major technical limitations relative to VOC in water in the mid-1970s. They were: (1) the volatile and, thus, transient nature of VOC during sample handling, (2) an aqueous matrix which may be considered deleterious to expensive analytical instrumentation, and (3) the presence of VOC at microgram per liter concentration levels in sometimes complex mixtures. Vapor pressure studies show that not all small molecules have identical vapor pressure, and small changes in molecular structure, such as the presence of polar bonds (O-H in ethanol versus nonpolar O-CH2CH3 in ether) lead to startling differences in vapor pressure. Because VOC are often found in mixtures rather than isolated species, and because molecule-specific detectors do not exist, gas chromatographic methods are ideal to physically separate individual component in a sample before measurement using a detector. A model for loss of VOC from the Tennessee River was developed and tested, which can be used to make decisions on the best placement of sampling sites. (Garrison-Omniplan)
W84-00851

QUALITY-ASSURANCE DATA FOR ROUTINE WATER ANALYSIS IN THE LABORATORIES OF THE U.S. GEOLOGICAL SURVEY: 1981 ANNUAL REPORT,
Geological Survey, Denver, CO. Water Resources Div.
D. B. Pearst, and N. Thomas.
USGS Water-Resources Investigations Report 83-4090, 1983. 112 p, 184 Fig, 5 Tab, 7 Ref.

Descriptors: Alkalinity, *Chemical analysis, Chlorophyll a, Dissolved solids, *Heavy metals, Nitrogen compounds, Phosphorus, Specific conductivity, Statistics, *Trace elements, *Trace metals, *Water analysis, *Quality-assurance data.

The U.S. Geological Survey maintains a quality-assurance program based on the analysis of reference samples for its two water-analysis laboratories located in Atlanta, Georgia and Denver, Colorado. Reference containing inorganic constituents are prepared at the U.S. Geological Survey's Ocala, Florida, office and disguised as routine samples, and sent daily to each laboratory through other U.S. Geological Survey offices. The results are permanently stored in the National Water Data Storage and Retrieval System (WATSTORE), the U.S. Geological Survey's data base for all water data. These data are analyzed statistically for precision and bias. The results of these statistical analyses are presented for data collected during the 1981 calendar year. In addition, one sample containing known concentrations of trihalomethanes and samples containing unknown concentrations of chlorophyll a were analyzed in both laboratories, and these results also are presented. (USGS)
W84-00897

SPECIFIC IDENTIFICATION OF ORGANIC POLLUTANTS IN HAW RIVER WATER USING GAS CHROMATOGRAPHY/MASS SPECTROMETRY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
A. M. Dietrich, D. S. Millington, and R. F. Christman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140524, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 206, August 1983, Raleigh, NC. 130 p, 20 Fig, 23 Tab, 3 Ref, 1 Append. A-127-NC(1), 14-34-0001-2135.

Descriptors: *Water pollution, *Rivers, *Organic compounds, *Pollutant identification, *Gas chromatography, *Mass spectrometry, Water quality, Water sampling, Organic pesticides, Phosphorus compounds, Industrial wastewater, Municipal wastewater, Wastewater disposal, Sample preparation, Resins, Mass spectra, Trace levels.

This study investigated organic pollution in the Haw River of North Carolina utilizing current advanced methods for extraction and concentration of aqueous trace organic pollutants combined with identification by Gas Chromatography/Mass Spectrometry (GC/MS). During the one and one-half year study, fifty-two different trace organics were detected in water in samples taken from three sampling sites on the Haw River. The sampling site at the Town of Haw River, located in the industrialized Piedmont, contained the greatest number of trace organic compounds. The sampling site at Bynum, downstream from the Town of Haw River, contained fewer compounds and were frequently the same compounds as those identified at the Town of Haw River site. Water analyzed from Oak Ridge, located upstream from the Town of Haw River, contained the fewest trace organic

contaminants and these pollutants were chemically dissimilar to those found at the other two sites. A trace organic pollutant profile of the Haw River has emerged from this work. The fifty-two organic pollutants detected and identified were determined to be in low microgram/liter (ppb) concentrations, although they contained only three priority pollutants. This data should not be interpreted as a survey or monitoring study of organic composition of the Haw River, since few sampling sites were involved and the purpose was focused on evaluating analytical methodology.
W84-00959

5B. Sources Of Pollution

RECONNAISSANCE FOR DETERMINING EFFECTS OF LAND USE AND SURFICIAL GEOLOGY ON CONCENTRATIONS OF SELECTED ELEMENTS ON STREAMBED MATERIALS FROM THE COAL MINING, REGION, SOUTHWESTERN INDIANA, OCTOBER 1979 TO MARCH 1980,
Geological Survey, Indianapolis, IN. Water Resources Div.
W. G. Wilber, and R. R. Boje.
USGS Water-Resources Investigations 82-4013, Nov. 1982. 39 p, 2 Fig, 6 Tab, 40 Ref.

Descriptors: *Bottom sediments, *Coal mining, *Heavy metals, *Indiana, *Land use, Particle size, *Statistical analysis, Streambeds, *Analysis of variance, Agricultural watersheds, Forest watersheds, Trace elements.

Streambed materials were collected in October 1979 from 69 watersheds in Southwest Indiana having predominantly forested, agricultural, reclaimed, and unreclaimed mined land use to determine whether concentrations of sorbed and acid-soluble metals and trace elements were affected by land use and surficial geology. Analysis of variance indicated that 10% or more of the total variation in aluminum, arsenic, cobalt, iron, nickel, selenium, and zinc concentrations on streambed materials was accounted for by differences in land use. Concentrations of aluminum, cobalt, iron, nickel, selenium, and zinc on streambed materials smaller than 0.062-millimeter from mined watersheds were significantly greater than the concentrations of these elements on streambed materials from agricultural and forested watersheds. The greater concentrations of these elements on streambed materials are due to (1) their concentrations in mine drainage and their subsequent absorption and (or) copecipitation with the oxides and hydroxides of aluminum and iron and (2) their concentrations in coal and pyritic material in streambed materials. (USGS)
W84-00771

EFFECT OF URBANIZATION ON THE WATER RESOURCES OF WARMINSTER TOWNSHIP, BUCKS COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
R. A. Sloto, and D. K. Davis.
USGS Water-Resources Investigations 82-4020, Jan. 1983. 72 p, 20 Fig, 16 Tab, 28 Ref.

Descriptors: *Urbanization, *Groundwater, *Organic solvents, *Water pollution sources, Lead, Trichloroethylene, Tetrachloroethylene, *Pennsylvania, Bucks County, Montgomery County.

Rapid suburban development occurred in Warminster Township after World War II, resulting in a large population dependent on groundwater. A stream-gain-and-loss study showed that losses from Little Neshaminy Creek were equal to 57% of the water pumped from wells near the stream. Groundwater infiltration to sewers was about 850 million gallons in 1979, and about 250 million gallons in 1980. In a year with average precipitation, (45 inches), evapotranspiration is about 24 inches and recharge about 11 inches. As much as 1.1 million gallons per day of additional water may be attached by drilling and pumping wells in areas not now affected by groundwater pumping. Contamination by volatile organic compounds has caused the water from some wells to be unsuitable for public supply. The median concentration of lead in groundwater, 17 micrograms per liter, is above the national median concentration. The concentration of most dissolved constituents increased in water from seven wells sampled at the onset of urbanization in 1953 and 1956 and again in 1979. Effluent from sewage treatment plants has degraded the chemical quality of stream at low flow. (USGS)
W84-00774

STATUS OF GROUND WATER QUALITY IN LOGAN TOWNSHIP, GLOUCESTER COUNTY,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
L. R. Miller, H. Kachroo, S. Andres, and R. Riccio.
Report, February 1982. 158 p, 6 Fig, 4 Tab, 9 Ref, 1 Append.

Descriptors: *Water quality, *Industrial wastes, *Pollutants, *Organic wastes, *Groundwater pollution, *Water pollution sources, Confined aquifers, Groundwater movement, Water sampling, Chemical analysis, Well water, Test wells.

The New Jersey Division of Water Resources (DWR) evaluated the ground water impacts from four possible industrial sources of contamination in Logan Township. DWR sampled 89 wells. The investigation detected ground water contamination at the Monsanto Chemical Company site, but no off-site contamination can be attributed to Monsanto's operation. Ground water contamination has been present since 1972 at Rollins Environmental Services, a hazardous waste treatment facility. Pollutants have been detected to a depth of approximately 70 feet. However, the samples showed that no private residential wells had been contaminated as a result of Rollins' waste disposal practices. Monitoring wells in the vicinity of Bridgeport Rental and Oil Services and Chemical Leaman Tank Lines detected extremely high concentrations of organic pollutants in both ground water and in a deep well between those two industrial sites. Serious contamination of the shallow, intermediate, and deep ground water zones has been detected at the Chemical Leaman site. Public water supply wells had no detectable levels of organic contaminants. Lead levels in one of the public wells was slightly elevated (53 parts per billion in March 1981) and will be monitored, although none of the industries is considered responsible for this condition. DWR recommended a program for future sampling of ground water in the affected areas. (Fazio-Omniplan)
W84-00782

THE STATE WATER PLAN, SUBBASIN 19, MONONGAHELA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6D.
W84-00785

THE STATE WATER PLAN, SUBBASIN 18, LOWER ALLEGHENY RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-18, July 1982. 186 p, 21 Fig, 49 Tab, 6 Append.

Descriptors: *Surface water, *Water pollution sources, *Acid mine drainage, *Coal mine wastes, *Flood damage, *Raw wastewater, Rivers, Sediment yield, Water pollution control, Stream pollution, Iron, Sulfates, Industrial wastes, *Pennsylvania, Allegheny River.

Major industrial areas, such as Pittsburgh and Johnstown are located along rivers in Pennsylvania's Subbasin 18. In addition to the steel industry, the economy of the subbasin also depends on its minerals, mainly coal, gas, oil, sand, gravel and clay. Acid mine drainage and nutrient enrichment due to inadequately treated municipal and industrial waste discharges are the major water quality problems in the subbasin. The Kiskiminetas River has been depressed by raw sewage discharges in the Vandergrift area; however, this w should be corrected by the new sewage tre plant. Proposed abatement projects in the legs and Loyalhanna Creek watersheds w prove the water quality in both watersheds. of the Pennsylvania Turnpike nearly every tributary contributes an acid load from mine age areas. This pollution, along with raw discharges, accounts for the severely de water quality of Stony Creek. Proposed abe projects in the area upstream of Hooversvil reduce the acid load by 8,860 pounds/da clean up more than ten miles of the stream. sheds D and E are characterized by high in sulfate concentrations. The average sedimen for the subbasin is about 436,000 tons pe This is relatively high in comparison to subbasins and is probably due to past and p mining activities. Subbasin 18 has exper some of the worst flood damage in the state structural solutions will be the most ef means of dealing with remaining flood probl this subbasin. The area's current total water 1,453 mgpd is one of the highest in the (Garrison-Omniplan)
W84-00786

THE STATE WATER PLAN, SUBBASI OHIO RIVER.
Pennsylvania Dept. of Environmental Reso Harrisburg. Office of Resources Management Report SWP-20, January 1983. 205 p, 21 F Tab, 6 Append.

Descriptors: *Acid mine drainage, *Stream tion, *Rivers, *Stream improvement, *S water, *Industrial wastes, Sedimentation, M pal wastes, Dissolved solids, Groundwater tion, Water pollution effects, Water pol sources, Mine wastes, *Pennsylvania, Ohio

All of subbasin 20 lies within the Appala Plateaus Province, an area whose econo largely based on its minerals. Surface water q is affected by acid mine drainage, although m pal and industrial wastes also cause some de tion. Groundwater quality is depressed on gional basis by iron, and in localized are landfill leachate and seepaage from waste st lagoons. The Ohio River is degraded by raw inadequately treated sewage discharges, as w by heavy metal concentrations from indu wastes. Implementation of plans to upgrade ment plants, and compliance by industries on to modify their facilities, will reduce some o pollution. Both industrial and domestic wast charges originating in Ohio affect the Mah River, a tributary of the Beaver River. Sli Rock Creek and several of its tributaries are a ed by acid mine drainage. The main stem ha experienced some sedimentation problems high amounts of dissolved solids due to active pit limestone mining, and strip and deep mining activities. A planned abatement proje the watershed will result in 13 miles of main being cleaned up, along with 6.5 miles of t taries and 4.5 miles of main stem being impro Subbasin 20 has experienced significant damage in the last half century because of u ization and the location of communities alon Ohio and Beaver Rivers and their tributa There have been 50 damage centers and 11 da reaches identified in the subbasin. Total wate is about 1,914 mgd of which 518 mgd is attrib to self-supplied industry, primarily steel man turing. (Garrison-Omniplan)
W84-00787

IRON IN GROUND WATERS OF THE GOTHY AND RARITAN FORMATIONS CAMDEN AND BURLINGTON COUNT NEW JERSEY,
D. Langmuir.
New Jersey Department of Conservation and nomic Development, Water Resources Circ No 19, Trenton, 1969. 49 p, 9 Fig, 4 Tab, 16 R Append.

Descriptors: *Iron, *Hydrogen ion concentra *Chemical analysis, *Water quality, Areal hy geology, *Groundwater pollution, Geohydrol

, Potable water, Dissolved solids, Ground-
echarge, Cations, Anions, Pumpage, Well
*New Jersey, Camden County, Burlington
Raritan aquifer, Magothy aquifer.

the major quality problem in potable
waters of the Magothy and Raritan aquifer
n Camden and Burlington Counties, New
Most wells tapping the aquifer system in
yield total iron concentrations in excess of
gram per liter. The iron is present primar-
ssolved ferrous iron and as colloidal-sized
ydroxide. Four water quality zones are
n terms of dissolved solids, pH, prevalent
character, and iron content as analyzed
oundwater samples from 185 wells. The
water in zones 1 to 3 is primarily of the
bicarbonate type, whereas in zone 4 it is of
um-bicarbonate type. The water quality
ydrologic data suggest that heavy, long-
npage in the vicinity of Philadelphia and
parts of New Jersey has induced the flow
3 ground waters up to seven miles in a
direction towards this area since 1900.
ent of the ground water within the aquifer
o marked seasonal changes in pumpage
e local groundwater movement of up to
with corresponding changes in iron con-
e information will be of interest in the
ea to owners of existent wells, water-
rsonnel, and persons faced with deciding
drill new wells likely to yield ground-
w in iron. (Fazio-Omniplan)
90

GEOCHEMISTRY OF THE NEW
PINE BARRENS,
Columbus Div., OH.
ns, R. F. Yuretich, D. A. Crerar, D. J. J.
and M. P. Borcsik.
sey Dept. of Environmental Protection
76, Trenton, 1981. 107 p, 39 Fig, 18 Tab,
3 Append.

rs: *Areal hydrogeology, *Areal precipi-
*Running waters, *Chemical analysis,
Bacterial analysis, Trace metals, Organic
tuaries, Iron oxides, Iron bacteria, Rain-
minum, Chemistry of precipitation, Bio-
, Potable water, *New Jersey, Pine Bar-

ument summarizes the current level of
chemical knowledge of the New Jersey
rens, identifies some basic geochemical
unique in type and degree to the Pine
ecosystem, and provides a technical basis
er research in soil and water chemistry
hemistry. The Pine Barrens rivers are
many aspects and differ markedly from
istry of the 'world average river.' Many
rens waters, while potable, have some
le characteristics that could be corrected
ent, such as by charcoal filtration. Pollut-
l and river waters would adversely influ-
chemistry of the estuarine environment as
s is particularly critical because many
f fish and shellfish live or breed in this
upplying a multimillion dollar industry.
ue and fragile ecosystem of the Barrens is
ependent upon both the quality and quan-
ground and surface waters. This delicate
now seriously endangered by encroach-
ban sprawl. The results of this study can
ict and measure the effects of encroach-
development. Strict regulations concern-
quality, water supply, and land develop-
required. The results of the study may be
data base for comparison with the hydro-
of the entire Atlantic Coastal Plain.
nniplan)
3

SURVEILLANCE AND ANALYSIS:
UNK CREEK AND LITTLE BEAR
WATERSHEDS,
The State Univ., New Brunswick, NJ.
sources Research Inst.
le, Jr., A. W. McIntosh, and J. V.

Water Quality Planning Program Report, April 1980, Mercer County, NJ, 85 p, 19 Fig, 12 Tab, 25 Ref, 5 Append.

Descriptors: *Stream pollution, *Water quality, *Biological samples, Watershed management, Water pollution sources, Fish, Ecosystems, Benthic fauna, Macroinvertebrates, Heavy metals, Pollutants, Industrial wastes, Organic wastes, Coliforms, Storm runoff, *New Jersey, Shabakunk Creek watershed, Little Bear Brook watershed.

This report evaluates conditions of water pollution and environmental degradation in the watersheds of Shabakunk Creek and Little Bear Brook, New Jersey. The work was undertaken to determine probable causes of observed adverse conditions and, given sufficient information, to determine preventive or remedial programs. The watershed of the West Branch Shabakunk Creek is highly urbanized and environmentally impacted. The Main Branch Shabakunk and Little Bear Brooks are less seriously polluted although Little Bear may periodically have received discharges of hazardous organic wastes. In both watersheds, biological survey and analysis complemented the data obtained by water quality sampling. Although no known point sources enter the Shabakunk Creek, sections of the creek below developed areas are in poor biological condition, with only a few small fish and pollution-tolerant groups of benthic macroinvertebrates present. Water quality analyses indicated that fecal coliform counts often exceed the New Jersey standard of 200 per 100 ml for FW-2 waters. Scrapings from riffles below the most developed areas contained the highest heavy metal concentrations. The presence of storm water runoff and illegal discharges remains a serious problem. Little Bear Brook apparently receives sewage contamination from residential areas. Mercer County will develop guidelines for stream surveillance and analysis studies for use by other areas designing similar efforts. (Fazio-Omniplan) W84-00801

MERCER COUNTY STORMWATER TOXICS MANAGEMENT PROJECT: DELAWARE AND RARITAN CANAL CONDUIT SPECIAL STUDY, TRENTON, NEW JERSEY.
Mercer County Planning Div., Trenton, NJ.
New Jersey Department of Environmental Protection and Mercer County Water Quality Planning Program, Final Report, 1982. 115 p, 11 Fig, 28 Tab, 48 Ref, 3 Append.

Descriptors: Water quality, *Water quality management, *Storm runoff, *Storm sewers, *Urban runoff, *Chemical analysis, *Pollutants, Canals, Drainage effects, Drainage water, Biochemical oxygen demand, Hydrocarbons, Heavy metals, Polychlorinated biphenyls, Pesticides, Biological samples, Benthic fauna, Enforcement, *New Jersey, Trenton, Mercer County.

A two year study of stormwater runoff in the Trenton, New Jersey area determined the nature and extent of toxic substances entering the Delaware and Raritan Canal, which is extensively used for boating, fishing, swimming, and drinking water supply. Earlier studies had detected toxic pollutants, such as heavy metals, polychlorinated biphenyls, and pesticides in Canal sediments, which were suspected to be entering the Canal through storm sewer discharges. Physical, chemical, and biological sampling and analyses substantiated the need to properly manage the quality of stormwater runoff entering valued water resources. The methodology was based on Mercer County's earlier 'stream surveillance' studies. The study found concentrations of biological oxygen demand, total hydrocarbons, and heavy metals in urban stormwater runoff similar to those reported in the literature. Cadmium, copper, lead and zinc were the predominant heavy metals found. Highway runoff contained lower levels of contamination than urban stormwater runoff. Stormwater runoff from urban residential as well as industrial and commercial areas contained high levels of contamination. Biological surveys identified the greatest effects of pollution nearest the inlet and outlet of the Trenton Conduit. Concentrations of existing contaminants in sediments appeared to be highly localized. Several monitoring and inspection programs are recommended to track the quality of reclining waters, drinking waters and pollutants. (Fazio-Omniplan) W84-00802

WATER-QUALITY ASSESSMENT OF THE AMERICAN RIVER, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
M. V. Shulters.
USGS Open-File Report 82-763, December 1982. 66 p, 40 Fig, 11 Tab, 36 Ref.

Descriptors: *Water quality, Water quality standards, *Water use, *California, *American River, *Time trend analyses, Specific conductance, Hardness, Alkalinity, *Urban runoff.

Based on an analysis of water-quality data from more than 168 sites, the American River was found to be of overall good quality and suitable for all beneficial uses specified by the State of California, even though its natural condition has been altered by man's activities in the basin. Time trend analyses indicate an increase in specific conductance (dissolved solids), hardness, and alkalinity over the past 20 years in the lower American River near Sacramento downstream from treated effluent and urban runoff sources. Most violations of specific water quality objectives for the basin have occurred in this segment. Water-quality conditions in the segment are expected to improve in 1982 when sewage treatment facility discharges will be discontinued. Potential water-quality problems in the upper American River basin could result from recreational overuse, improper land-use or poorly managed mining operations. Recreational overuse and increased urban runoff are the principal threats to water quality in the lower American River. Proposed monitoring activities include low-flow investigations on the lower American to measure diurnal variations in water-quality characteristics and studies in the uppper basin to determine the impact of increasing recreation and development as well as the effects of mine discharge. (USGS) W84-00828

SUBBASINS 14 AND 16, GENESEE RIVER AND UPPER ALLEGHENY RIVER,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00838

SUBBASIN 11, UPPER JUNIATA RIVER,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00839

SUBBASIN 15, LAKE ERIE,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00840

STATE WATER PLAN: SUBBASIN 10, LOWER WEST BRANCH SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00843

STATE WATER PLAN: SUBBASIN 9, CENTRAL WEST BRANCH SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00844

STATE WATER PLAN: SUBBASIN 8, UPPER WEST BRANCH SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-9, June 1979. 121 p, 18 Fig, 41 Tab, 6 Append.

Descriptors: *River basins, *Acid mine drainage, *Stream pollution, *Acidic water, *Thermal pollution, *Aquatic habitats, *Water quality, Streams, Rivers, Water policy, Groundwater pollution, Flood control, Flood damage, *Pennsylvania, Upper West Branch Susquehanna River.

Most of the northern half of Subbasin 8 in Pennsylvania is in state ownership, and is primarily state forest land; however, it also includes state game lands and state Parks. The subbasin is described in one of 23 reports being published as a result of initial investigations and studies conducted in connection with the State Water Plan of the Commonwealth. Mining operations have impacted negatively on the land and water resources here. Whereas the upper basin has been left relatively undeveloped and preserved, the lower basin has been scarred and left with acid streams unfit for biologic habitat. As a result, the general water quality of Subbasin 8 is poor. Many of the problems originate in tributaries and headwaters to the West Branch Susquehanna River. Limestone in Watershed B neutralizes the acidity upstream, leaving high concentrations of total dissolved solids from calcium and magnesium in the limestone and from the iron, manganese and sulfates in the coal. Thermal pollution from the Shawville electric power generating plant would be a problem were it not that aquatic life has already been eliminated by the high acidity in the river. There have been incidents of groundwater pollution; better land management practices are needed to reduce such incidents in the future. There are only 295,000 tons of sediment leaving the basin each year, one of the smallest erosion rates in the state. Flood damages are common because of the mountainous terrain. (Garrison-Omniplan)
W84-00845

STATE WATER PLAN: SUBBASIN 7, LOWER SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00846

STATE WATER PLAN: SUBBASIN 6, LOWER CENTRAL SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6D.
W84-00847

THE PUERCO RIVER: MUDDY ISSUES RAISED BY A MINE WATER DOMINATED EPHEMERAL STREAM,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
B. Gallaher.
Proceedings of Twenty-eighth Annual New Mexico Conference, 'Water Quality in New Mexico,' April 5-6, 1983. WRRI Report No 169, New Mexico Water Resources Research Institute, Las Cruces, June 1983. p 60-68, 9 Fig, 1 Tab, 2 Ref.

Descriptors: *Ephemeral streams, Intermittent streams, *Radioactive wastes, *Uranium, *Dewatering, *Water quality standards, Stream pollution, *State jurisdiction, Legal aspects, Water policy, Water resources institutes, Hazardous materials, *New Mexico, Puerco River.

Increased urbanization and industrialization has caused an increase in the disposal of wastewater in ephemeral watercourses. Because there is minimal in-stream dilution of wastewater, the impacts on ground water may be more severe than from a discharge to a perennial stream. Since 1968, dewatering of underground uranium mines in the Church Rock Uranium Mining District has caused perennial flow in the Puerco River. During 1982, the discharge rate was nearly 5,000 gallons of mine dewatering effluent per minute. Although the quality of water discharged from the mines is regulated, the quality of water in the Puerco River itself is subject to little regulatory control in New Mexico. Because of its ephemeral nature, the Puerco River has no designated uses. Therefore, there are no specific stream standards applicable to that channel except the narrative general standards applicable to all surface waters of the state. Arizona has determined that its segment of the Puerco River should be protected for aquatic life, wildlife, irrigation and livestock. Eighteen numerical standards have been developed for metals, radionuclides and nutrients. A recent report by the Environmental Improvement Division noted that the Puerco River contains levels of radioactivity and certain toxic metals that approach or exceed standards or guidelines designed to protect the health of people, livestock and agricultural crops. Data suggest that no level of improvement in effluent quality would render the river totally suitable for these uses. (Garrison-Omniplan)
W84-00853

HYDROCARBON FUELS IN GROUND WATER--INCREASED AWARENESS AND CONCERN IN NEW MEXICO,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
D. Jercinovic.
Proceedings of Twenty-eighth Annual New Mexico Conference, 'Water Quality in New Mexico,' April 5-6, 1983. WRRI Report No 169, New Mexico Water Resources Research Institute, Las Cruces, June 1983. p 35-47, 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Aromatic hydrocarbons, Pollutants, *Hazardous materials, *Chemical wastes, *Industrial wastes, *Data collection, *Surveys, *Water pollution effects, Lubricants, Oil, Petroleum products, State jurisdiction, *New Mexico.

The New Mexico Environmental Improvement Division (EID) has become increasingly aware of the waste contamination problems associated with the leakage and surface disposal of hydrocarbon fuels, including refined petroleum products such as gasoline, kerosene, gas oil (diesel fuel), fuel oils and lubricating oils. The aromatic hydrocarbons commonly found in gasoline include compounds such as benzene, toluene and xylenes, all of which are extremely soluble in ground water. Sources of contamination are the six active gasoline refineries in New Mexico, which are responsible for transportation of hydrocarbon fuels, storage and handling, and disposal. In June 1982, the EID began to inventory all known or suspected cases of hydrocarbon fuel contamination of ground water as a first step in evaluating statewide impacts. Of the 78 incidents recorded, more than 32% were associated with underground leakage of hydrocarbon fuels from commercial retail outlets. Property damage and aquifer restoration costs have climbed as high as $10 million from a single leaking underground gasoline tank. Preliminary suggestions include periodic tank testing of all underground fuel storage tanks, requiring hydrocarbon fuels or hydrocarbon fuel-contaminated water to be discharged into lined evaporation ponds, prompt reporting of all losses to local or central EID offices, and accurate daily inventories of all stored fuels. (Garrison-Omniplan)
W84-00854

GROUND WATER QUALITY IN THE SOUTH OF ALBUQUERQUE,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
D. M. McQuillan.
Proceedings of Twenty-eighth Annual New Mexico Conference, 'Water Quality in New Mexico,' April 5-6, 1983. WRRI Report No 169, New Mexico Water Resources Research Institute, Las Cruces, June 1983. p 48-59, 1 Fig, 4 Tab, 11 Ref.

Descriptors: *Groundwater pollution, *Evapotranspiration, *Chemical wastes, *Ions, *Minerals, *Organic wastes, *Groundwater contamination, Water table, Water quality, Selenium, Strontium, Uranium, Vanadium, Water pollution effects, *New Mexico, Albuquerque, South Valley.

Ground water quality problems in the Albuquerque South Valley date back to at least 1927. Possible causes for these problems include evapotranspiration, contaminant discharges and nat
curring, water-soluble materials. A stud
New Mexico Environmental Improvem
sion (EID) of water samples from two
supply wells in San Jose found two s
chlorinated two-carbon compounds and o
of diesel oil. Potential sources of the orga
pounds include chemical and petroleum
handling facilities, manufacturing or proc
tablishments, sewer lines, dumps and
products such as septic tank and cesspool
solvents. The San Jose area has been d
the state's top priority 'superfund' site.
city of Mountainview's excessively mi
ground water has caused water supply
since 1961. The worst cases historically a
eral hundred mg/l of nitrate-nitrogen and
with most other major ions also at high co
tion. Bicarbonate levels, however, are
low, e.g., 151 mg/l. Recently sampled we
contained anomalously high levels of
strontium, uranium, vanadium and
oxygen demand. The causes of the Moun
problem remain a mystery. Regarding othe
the state, gasoline has been found flo
ground water at two locations near U.S.
where the ground water depth is only te
less. The Pajarito area has reported elev
trate levels. (Garrison-Omniplan)
W84-00856

**GEOHYDROLOGIC RECONNAISSAN
DRAINAGE WELLS IN FLORIDA--AN
IM REPORT,**
Geological Survey, Tallahassee, FL. W
sources Div.
For primary bibliographic entry see Field
W84-00865

**A PLAN FOR HYDROLOGIC INVE
TIONS OF IN-SITU OIL SHALE RETO
NEAR ROCK SPRINGS, WYOMING,**
Geological Survey, Cheyenne, WY. Wa
sources Div.
For primary bibliographic entry see Field
W84-00873

**WATER-QUALITY RECONNAISANCE
NORTH DATA COUNTY SOLID-WAS
POSAL FACILITY, FLORIDA,**
Geological Survey, Tallahassee, FL. Wa
sources Div.
D. J. McKenzie.
Available from the OFSS, USGS Lakewo
80225, Price $5.50 in paper copy, $3.50 i
fiche. USGS Open-File Report 82-753, 19
10 Fig, 7 Tab, 18 Ref.

Descriptors: Water quality, *Landfill, *L
Limestone aquifer, Organic decomposition
waste, Biscayne aquifer, Nitrification, Chl
dicator, Alkalinity, Electrical resistivity
*Florida, Dade County.

A water-quality sampling reconnaissance
north Dade County solid-waste disposal
(landfill) near Carol City, Florida, was co
during 1977-78. The purpose of the reconn
was to determine selected quality characte
the surface- and ground-water of the land
contiguous area; and to assess, generally,
ate produced by the decomposition of
wastes was adversely impacting the down
water quality. Sampling results indicated t
eral water-quality characteristics were pr
landfill ground water at significantly highe
than in ground water upgradient or downg
from the landfill. Moreover, many of these
quality characteristics were found at
higher levels at down gradient site 5 than a
dient site 1 which suggested that some d
dient movement of landfill leachate had oc
For example, chloride and alkalinity in
water had average concentrations of 20
mg/L at background wells (site 1), 144
mg/L at landfill wells (sites 2 and 4), and
338 mg/L at downgradient wells (site 5).
parison of the 1977-78 sampling results w
National Primary and Secondary Drinking
Regulations indicated that levels of iron an

nd water of the study area frequently ex-
national maximum contaminant levels, dis-
solids, turbidity, lead, and manganese occa-
exceeded regulations. Concentrations of
d levels of color and turbidity in some
water samples also exceeded National
m contaminant levels. (USGS)
874

NNAISSANCE OF STREAM BIOTA AND
CAL AND CHEMICAL QUALITY FROM
TED LAND USE ON STREAM BIOL-
IN THE COAL-MINING REGION,
IWESTERN INDIANA, 1979-80,
ical Survey, Indianapolis, IN. Water Re-
Div.
angsness.
le from the USGS, OFSS Lakewood, CO
Price $6.00 in paper copy, $3.50 in micro-
USGS Open-file Report 82-556, August
p, 18 Fig, 3 Tab, 25 Ref.

tors: *Algae, *Aquatic environment,
habitat, Aquatic insects, Chemical proper-
lorophyll, Coal mines, *Indiana, Inverte-
Biological assessment, *Coal hydrology,
tic algae.

meet the goals of the Surface-Mining
and Reclamation Act of 1977, the U.S.
cal Survey is assessing the physical, chemi-
biological characteristics of surface water
he coal-mining region of southwestern In-
his report discussed benthic-invertebrate
phytic-algal communities in streams drain-
ogeneous agricultural, forested, active/re-
mine, and unreclaimed mine watersheds,
es the biological communities to the phys-
chemical characteristics of the streams.
y and pH were lower and the concentra-
dissolved solids, calcium, magnesium,
potassium, sulfate, iron, manganese, alumi-
d zinc were higher in unreclaimed-mine
ds than in the other land-use watersheds.
s and community diversity of benthic in-
es were less at sites affected by mining
gricultural or forested sites, owing to (1)
ic effects of pH, metals, and unsuitable
nd (2) lack of colonizing drift organisms
of the small drainage area upstream from
d area. Only a few organisms, such as the
es Cheumatopsyche and Hydrosyche and
nomids Chironomus and Cricotopus were
streams draining mine areas. (USGS)
76

PHOSPHORUS LOADING FROM
SYSTEMS BY SEASONALLY
ED GROUND WATER, PUGET SOUND
N, WASHINGTON,
al Survey, Reston, VA. Water Resources

om, and C. R Patmont.
e from the OFSS, USGS, Lakewood, CO
rice: $3.50 in paper copy, $3.50 in micro-
GS Open File Report 82-907, 1982. 25 p,
Tab, 35 Ref.

rs: *Lake eutrophication, *Phosphorus,
ater contamination, *Septic tanks, Sto-
nalysis, Nutrient transport, Puget Sound
Washington, Pine Lake.

evious study, estimated phosphorus (P)
from septic systems to lakes in the Puget
gion were found to be correlated with the
of old homes around the lakes. In the
udy, we assessed the movement of septic-
in seasonally perched ground water near
e, a typical glacial-till lake in the region.
und water occurs in soils overlying less
e glacial till, which is prevalent around
e and many other lakes in the area. Water
were taken from 15 shallow (<1.5 meters)
talled 10-50 meters downgradient from
tic systems 20 to 40 years old. The equiv-
metric fraction of each sample consisting
ted effluent was estimated from chloride
ation. Using Monte Carlo analysis to ac-
the various sources of uncertainty, we
at, though movement of diluted septic effluent to the lake was common, transport of more than 1% of effluent P through the soil was probable ($p > or = 0.5$) for only 4 of 26 samples, was transport of more than 10% of effluent P probable. The highest probabilities of P movement were associated with two samples from a well that was downgradient from a drainfield located at the base of a hillslope depression where perched ground water concentrates and remains for extended periods. All evidence considered, most P loading to Pine Lake from septic systems appears to come from only a few older systems located in areas where perched ground-water flow and associated saturated soil conditions predominate for extended periods during the winter season. (USGS)
W84-00883

GROUNDWATER QUALITY IN NEW JERSEY--AN INVESTIGATION OF TOXIC CONTAMINANTS,
New Jersey Dept. of Environmental Protection, Trenton. Office of Cancer and Toxic Substances Research.
R. K. Tucker.
Report, March 1981. 60 p, 10 Fig, 8 Tab, 101 Ref, 1 Append.

Descriptors: *Chemical wastes, *Pesticide toxicity, *Groundwater pollution, *Groundwater contamination, *Chemical analysis, Water pollution, Hazardous materials, Water quality, Recharge, Poisons, Metals, *New Jersey.

Fifty chemicals in three groups--halogenated volatile organics, chlorinated pesticides and related compounds, and metals--were searched in well water samples throughout New Jersey. A total of 1,118 samples were taken from 670 sites. Although this is a significant sample size, it is a small portion of the more than 16,000 potable wells in the state. One or more of eight volatile organic compounds were found at concentrations above ten parts per billion in 16.6% of the wells tested. Five of the eight chemicals (carbon tetrachloride, chloroform, dichloroethane, tetrachloroethylene, and trichloroethylene) have been established via animal tests as capable of causing cancer and three others (trichloroethane, and the di-and tri-chlorobenzenes) are chemically similar to known carcinogens, but no reliable evidence exists to prove that they are carcinogenic. In 3.1% of the wells in the study, concentrations of one or more of these eight chemicals exceeded one hundred parts per billion, a clearly unacceptable level. It is hypothesized that low level concentrations of volatile organics may occur in wells subject to widespread contamination by a variety of mechanisms, including aerial transport and recharge from surface waters. In contrast, higher levels of contamination occur in a population of wells subject to direct and relatively nearby discharge of pollutants into the ground. Chlorinated pesticides and related compounds, when detected in this study, were usually at very low concentrations. (Garrison-Omniplan)
W84-00912

WATER-QUALITY ASSESSMENT OF THE MERCED RIVER, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
S. K. Sorenson.
USGS Open-File Report 82-450, November, 1982. 46 p, 21 Fig, 4 Tab, 18 Ref.

Descriptors: *Water quality, *Water quality standards, *Water use, *California, Merced River, Lake McClure, McSwain Reservoir.

The Merced River and its major tributaries have been subject of water-quality and water-quantity studies by local, State, and Federal agencies since before 1900. Data have been compiled and analyzed, and even though water-quality problems exist in the basin, the water generally is of good quality for most of the beneficial uses defined by the California State Water Resources Control Board. Water-quality objectives for dissolved oxygen, pesticides, and pH were violated in some parts of the basin. The most likely cause of the dissolved-oxygen and pesticide violations is the return of agricultural irrigation water to the river in the lower 30 miles of the river. Violations of pH objectives occurred only in the upper drainage and were likely due to naturally occurring, poorly buffered water. Water quality is currently being monitored at three stations in the basin by California Department of Water Resources, at one station by the U.S. Geological Survey, and at several sites by the National Park Service. Modifications to the current water-quality monitoring program are proposed to gain further information on dissolved-oxygen fluctuations and pesticide concentrations in the lower river and to investigate nutrient input to Lake McClue. (USGS)
W84-00924

RECONNAISSANCE OF STORMWATER-RUNOFF WATER QUALITY OF THE BIG PINEY CREEK SEGMENT OF THE CEDAR-PINEY WATERSHED, YELL COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
J. C. Peterson.
Available from the OFSS, USGS Lakewood CO 80225, Price: $2.75 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-761, May 1982. 14 p, 1 Tab, 12 Ref.

Descriptors: *Water quality, *Small watersheds, *Storm runoff, *Nutrients, Coliforms, Streptococcus, Iron, Manganese, Sediments discharge, *Arkansas, Watershed reconnaisance.

A reconnaissance of the Big Piney Creek watershed was made between June 1981 and January 1982 to assess the water quality of selected streams in the watershed. Streamflow was measured and water samples were collected three times at each of three sites during the study. All samples were collected during periods of stormwater runoff. The water was soft (7 to 20 milligrams per liter of hardness as calcium carbonate) and dissolved-solids concentrations ranged from 36 to 74 milligrams per liter. Suspended-sediment concentrations ranged from 7 to 144 milligrams per liter. The 5-day biochemical oxygen-demands, total-nitrogen concentrations and total-phosphorus concentrations ranged from 1.5 to 6.8 milligrams per liter, 0.54 to 5.8 milligrams per liter, and 0.03 to 0.56 milligram per liter, respectively. Fecal-coliform bacteria were present in large enough concentrations at two of the sites (340 to 490 colonies per 100 milliliters and 1,200 to 6,000 colonies per 100 milliliters) to indicate that the U.S. Environmental Protection Agency criterion for bathing waters and the Arkansas water-quality standard may be exceeded at times. Total-iron concentrations greater than 1,000 micrograms per liter (the U.S. Environmental Protection Agency criterion for protection of freshwater aquatic life) were detected at least once at all sites. (USGS)
W84-00933

NITRATE LOSS FROM AGRICULTURAL DRAINAGE WATERS: IMPLICATIONS FOR NONPOINT SOURCE CONTROL,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
T. C. Jacobs, and J. W. Gilliam.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140581, Price codes: A11 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Completion Report Nc 209, September 1983. 222 p, 50 Fig, 27 Tab, 34 Ref, 12 Append. OWRT B-129-NC(1), 14-34-0001-0238.

Descriptors: *Denitrification, *Drainage effects, *Buffers, *Agricultural watersheds, *Nitrogen losses, *Nitrogen movement, Nitrates, Soil water movement, Riparian vegetation, Water pollution sources, Fertilizers, Drainage water, Subsurface drainage, Surface runoff, *North Carolina, Coastal plain.

The amount and fate of nitrogen moving from agricultural fields in two watersheds of the North Carolina Coastal Plain were examined. The possible sinks for this nitrogen and their effects on stream concentration were determined. At the Beaverdam Creek watershed where well- and moder-

ately well-drained soils dominate the agricultural fields, nitrogen readily moved from the fields. However, between most fields and the natural streams, there were buffer strips with heavy riparian vegetation. These buffer areas with poorly drained soils resulted in significant losses of nitrate before the water reached the stream. Very narrow buffer strips were effective for this removal and these strips normally line streams on the Middle Coastal Plain. In soils with subsurface drainage entering ditches via tile lines or subsurface flow, the losses of nitrogen to surface waters were much greater. In watersheds of the Upper and Middle Coastal Plain in-stream losses of nitrogen are not sufficient to reduce heavy loading by nonpoint sources. The floodplains, which have a high capacity to reduce nitrate, usually flood in the winter when temperatures are too low for extensive losses. At the Creeping Swamp watershed in the Lower Coastal Plain, a dense clay layer below the surface horizons reduces subsurface drainage losses of water and nitrogen to very low levels.
W84-00965

HYDROGEOCHEMICAL CYCLING IN A WATERSHED-GROUNDWATER SYSTEM: FORT RIVER AND CADWELL CREEK, MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
G. L. Batchelder, R. F. Yuretich, and W. C. Leonard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140607, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 145, Massachusetts Univ., Amherst, September 1983. 80 p, 29 Fig, 7 Tab, 32 Ref. OWRT A-138-MASS(1), 14-34-0001-2123.

Descriptors: *Acid rain, *Acid streams, *Acidic soils, *Alkaline soils, *Cation exchange, *Chemical analysis, Acidic water, Acidity, Alkaline water, Alkalinity, Chemical composition, Erosion, Geochemistry, Glacial soils, Ion exchange, Rainfall-runoff relationships, Soil chemistry, Well data, Watersheds, Domestic water, Fort River, *Massachusetts, Quabbin reservoir.

This study has determined the principal hydrochemical processes in the headwaters of the Fort River near Amherst, Massachusetts and has initiated a detailed analysis of groundwater in Cadwell Creek, a tributary of the Quabbin Reservoir. Incoming precipitation has an average pH of 4.06 and total dissolved solids of approximately 3.5 ppm, although seasonal variations do occur. Over 99% of the incoming H+ ions are being neutralized in the watershed, primarily by cation exchange and silicate weathering reactions. This produces stream water with a pH between 5.2 and 6.0, and total dissolved solids of 25 to 30 ppm. Major cations are leaving the watershed at a rate six times greater than they are entering. Ca super 2+ is removed fastest, followed in order by Mg super 2+, Na+, and K+. The total chemical denudation rate including SiO sub 2 and SO sub 4 super 2- is 6130 kg/km super 2/yr (about 1.5 times greater than that calculated for Hubbard Brook, New Hampshire). Surficial geology controls the specific composition of streamwater in individual subwatersheds. Drainage basins underlain by till are more effective at neutralizing precipitation acidity than those with abundant stratified drift and/or shallow bedrock. A similar relationship is evident in the composition of groundwater in Cadwell Creek. Research is continuing on Cadwell Creek wells.
W84-00967

TRANSPORT MODELING OF AN AGRICULTURAL HERBICIDE, A LABORATORY SIMULATION,
Kansas State Univ., Manhattan. Dept. of Civil Engineering.
E. C. McCall, Jr., D. D. Lane, and A. D. Parr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140623, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Contribution No 240, August 1983. 25 p, 11 Fig, 3 Tab, 23 Ref. OWRT A-106-KAN(1), 14-34-0001-2118.

Descriptors: *Herbicide runoff, *Laboratory simulation, *Atrazine, Soil flume, *Agricultural runoff, Clay loam, Rainfall, Transport modeling, Mass transport.

A one-dimensional flow, laboratory soil flume was used to simulate atrazine loss from a field during rainfall runoff events. Liquid atrazine was surface applied at a rate of 3360 g/ha to a Pawnee clay loam soil. Rainfall events of 1.3 cm/hr and 2.5 cm/hr of one hour durations were applied to the soil flume one day after atrazine application. The rainfall was simulated by overland flow only. The flume was 'placed' in upper, middle and lower locations in a 300 m long, 9% slope field. The soil was saturated and allowed to drain to field capacity before the rainfall event. The flume bottom was impervious to prevent infiltration. For this worst case condition, 90% of the atrazine lost was in the runoff water and the majority of the atrazine loss occurred within twenty minutes of the beginning of the runoff events. Thirty-five percent of the atrazine applied was transported from the field for both the 1.3 and 2.5 cm runoff events. No change in the mass transported by the two different intensity runoff events appears to be due to a limit placed on atrazine availability for runoff by the atrazine rate of desorption and dissolution. The desorption, dissolution process appears to be very slow, i. e., much greater than one hour, and thus the antecedent moisture conditions appear to place a finite limit on the atrazine which is available for runoff during a single event.
W84-00969

SITE STUDIES OF DETERMINE THE EXTENT AND POTENTIAL IMPACT OF HERBICIDE CONTAMINATION IN KANSAS WATERS,
Kansas State Univ., Manhattan. Dept. of Systematics and Ecology.
F. deNoyelles, Jr., and W. D. Kettle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140631, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Contribution No 239, September 1983. 37 p, 10 Fig, 8 Tab, 71 Ref, 2 Append. 0WRT A-104-KAN(1), 14-34-0001-2118.

Descriptors: *Herbicides, *Toxicant resistance, *Photosynthesis inhibitors, *Phytoplankton, *Macrophytes, Site studies, Aquatic habitats, Atrazine, Cyanazine, Propazine, Matribuzin, Simazine, Experimental ponds, Tailwater pits, Fish ponds, *Kansas.

The triazine herbicides have accounted for nearly one third of the total herbicide usage in Kansas in recent years. It is well known that these herbicides are entering aquatic habitats in Kansas and throughout the Midwest, yet little is known of their effects on the freshwater organisms residing there. This study was undertaken to accumulate data on triazine herbicide concentrations in State waters and to determine the biological impact of the triazines on phytoplankton and macrophyte communities at those sites. To develop baseline data on the biological effects of triazine herbicides, experimental ponds were treated with different levels of atrazine herbicide under highly controlled situations. Atrazine was chosen to represent the triazines because of its physiological effects on a wide variety of terrestrial and aquatic plants and because it is the single most heavily used pesticide in the United States. In the treated experimental ponds, communities of phytoplankton quickly developed which were more resistant to atrazine. Macrophytic vegetation was significantly inhibited in treated ponds. The next phase of the study involved sampling numerous aquatic habitats throughout the State to (1) analyze the concentrations of triazine herbicides (atrazine, cyanazine, metribuzin, and simazine) and to (2) determine if the macrophyte and phytoplankton communities at these sites had been altered by exposure to triazine herbicides. Triazines were detected at many sites and many of those sites were also found to contain phytoplankton communities possessing a degree of resistance to atrazine. Reductions in macrophyte communities were noted in those waters receiving direct runoff from agricultural fields.
W84-00970

HYDROLOGIC EFFECTS OF STORING QUIFIED SEWAGE SLUDGE ON S MINED LAND IN FULTON COUNTY, NOIS,
Geological Survey, Urbana, IL. Water Res Div.
For primary bibliographic entry see Field 5E.
W84-00977

HYDROGEOLOGY OF A LANDFILL O ATION, PINELLAS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Wate sources Div.
F. Mario, Jr.
Available from the National Technical Inform Service, Springfield, VA 22161 as PB83-20 Price codes: A03 in paper copy, A01 in micro USGS Water Resources Investigations 82-30, 35 p, 14 Fig, 4 Tab, 15 Ref.

Descriptors: *Landfills, Water quality, *Gr water movement, *Wet lands, Sanitary engi ing, Waste disposal, Path of pollutants, Sh water, *Leachate movement, *Landfill leac Specific conductance, Chloride, Chemical ox demand, Total organic nitrogen, Ammonia-gen, *Florida, Pinellas County.

The Pinellas County landfill site is on a flat, c area characterized by a high water table is s to tidal flooding. Altitudes within the study range from 8 to 12 feet above sea level. T geohydrologic units underlie the landfill s surficial aquifer about 19 feet thick compos sand and shells; a confining bed about 35 feet composed of marl and clay; and the Flo aquifer composed of limestone. The rate of l movement of ground water away from the s about 1.2 feet per year; however, the rate of m ment along the boundary of the landfill ca about 20 feet per year. Vertical movement thr the confining layer is about 0.005 foot per Landfill operations have not altered surface-w quality. Leachate migration downward into Floridan aquifer is not indicated, but data do cate leachate is migrating from the oldest se of the landfill site through the surficial aq Peaks in concentration of selected chemical pa eters and flow-rate analysis of water from tren indicate the possibility of slug-flow leac (USGS)
W84-00996

POLYCHLORINATED BIPHENYLS IN H SATONIC RIVER SEDIMENTS IN MAS CHUSETTS AND CONNECTICUT: DETER NATION AND TRANSPORT,
Geological Survey, Boston, MA. Water Resou Div.
C. R. Frink, B. Sawhney, K. P. Kulp, and C. G Fredette.
Connecticut Agricultural Experiment Sta New Haven, December 1982. 43 p, 12 Fig, 24 T 31 Ref.

Descriptors: *Polychlorinated biphenyls, *S ment, Transportation, *Distribution, *Riverb *Connecticut, *Massachusetts, Water quality, S pended sediment, Suspended load, Contamina Cores, Deposition, Particle size, Lake Zoar, *H satonic River, Woods Pond, Lake Lillinonah.

Samples of sediment from the Housatonic Rive Connecticut and Massachusetts indicate that PC have accumulated predominantly in impoun reaches of the river where sediment accumula is greatest. Distribution of PCBs within the poundments is controlled by sediment particle s greatest PCB concentrations are associated w fine-grained sediment. Study results indicate t an estimated total of 22,200 pounds of PCBs contained in the river sediments, 60% are in M sachusetts, predominantly in the Woods Pond a and 40% are in Connecticut. In Connecticut, ab 29% of the PCBs are in lake Lillinonah, 10% ar Lake Zoar, and the remaining 1% is distributed small amounts at other areas. The rate of transp of PCBs in the Housatonic River from Massac setts into Connecticut by suspended sediment estimated to be 250-500 pounds per year. (USG
W84-00999

...ATION OF WATER-QUALITY CHAR-
...ISTICS OF PART OF THE SPOKANE
...ER, WASHINGTON AND IDAHO,
... A SOLUTE-TRANSPORT DIGITAL
...L,
...ical Survey, Tacoma, WA. Water Re-
... Div.
...mary bibliographic entry see Field 2F.
...001

...AL HYDROLOGY AND EXTERNAL
...ES OF NUTRIENTS AFFECTING PINE
...KING COUNTY, WASHINGTON,
...cal Survey, Tacoma, WA. Water Re-
... Div.
...mary bibliographic entry see Field 2H.
...015

...MENT OF THE INTERCONNECTION
...EN TAMPA BAY AND THE FLORI-
...QUIFER, FLORIDA,
...cal Survey, Tallahassee, FL. Water Re-
... Div.
...ary bibliographic entry see Field 2F.
...19

...LOGY, WATER QUALITY, AND BIOL-
...F BAPTISTE COLLETTE BAYOU IN
...ON TO THE MISSISSIPPI RIVER AT
..., LOUISIANA,
...al Survey, Baton Rouge, LA. Water Re-
...Div.
...mary.
...a Department of Transportation and De-
...nt, Baton Rouge, Water Resources Tech-
...ort No 31, 1983. 49 p, 14 Fig, 12 Tab, 35

...ors: Coliform bacteria, Pathogenic bacte-
...eptococcus bacteria, *Benthic fauna,
...ediments, Flow patterns, *Trace metals,
..., *Saltwater intrusion, Distributary, Sedi-
...tribution, Tracers, *Water quality, Bap-
...ette Bayou distributary, *Lower Missis-
...er, State water-quality criteria, *Louisi-
...ce.

...ality including suspended sediment, fecal
...genic bacteria, and benthic invertebrates
...rmined from samples collected from Bap-
...ette Bayou distributary and the Mississip-
...t Venice from July 1980 to April 1982 to
... factors that influence water quality and
...bution of bacterial and benthic inverte-
...ulations within the system. Data on dis-
...nd time of travel were also collected.
...nples from Baptiste Collette Bayou and
...sippi River were similar in composition
...ntration during periods of moderate flow
...sissippi River but differed during periods
...er intrusion in the river. Minor-element
...r-pesticide concentrations were low in
...r and bayou samples. Total-coliform
...ceeded Louisiana State Water Quality
...or shellfish production 95% of the time
...tions. Pathogenic bacteria were isolated
...s and possible sources of bacterial input
...tified. Corophium, Nereis, Asebellides,
...oma were the organisms that occurred
...ently and in greatest numbers from river
...n samples. Saltwater intrusion and sub-
... appear to be the dominant factors influ-
...e kinds of organisms present and their
...n within the study area. (USGS)
...5

...TION OF SELECTED ONE-DIMEN-
... STREAM WATER QUALITY
... WITH FIELD DATA,
... Survey, Bay Saint Louis, MS. Water
... Div.
...utcheon.
...from the OFSS, USGS, Lakewood, CO
...e $24.25 in paper copy, $4.00 in micro-
...S Open-File Report 82-851, 1982. 182 p,
...Tab, 45 Ref.

...s: *Computer models, *Water quality,
..., *Hydrological data, *Arkansas River, Chattahoochee River, Willamette River, M.I.T. water-quality model, *Model comparison, QUAL II, USGS Steady-State water-quality model, WQRRS.

The U.S. Geological Survey One-Dimensional Stream Water-Quality Model, QUAL II Stream Water-Quality Routing Model, the U.S. Army corps of Engineers Water Quality for River Reservoir Systems Model, and the M.I.T. Transient Water Quality Network were evaluated and compared using actual water-quality data collected by the U.S. Geological Survey. The field data were taken from steady-state studies of the Chattahoochee River in Georgia, the Willamette River in Oregon, and the Arkansas River in Colorado. The data used to evaluate the models covered a wide range of physical, chemical, and biological conditions. The Willamette River is a large sluggish stream, whereas the Arkansas River is a small dynamic stream. The Chattahoochee River is of moderate size. Each stream has unique water-quality characteristics that test a wide range of model options. (USGS)
W84-01027

CHLOROFORM CONTAMINATION IN PART OF THE ALLUVIAL AQUIFER, SOUTHWEST LOUISVILLE, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
R. W. Davis, and E. W. Matthers.
USGS Water Supply Paper 2202, 1983. 25 p, 18 Fig, 2 Tab, 4 Ref.

Descriptors: Organic compounds, *Path of pollutants, *Pollutant identification, Soil contamination, Water pollution effects, *Water pollution sources, Groundwater movement, *Chloroform, *Carbon tetrachloride, Rising water levels, Adsorbtion, *Kentucky, Louisville.

A well in alluvium at Louisville, KY., has been yielding water with concentrations of chloroform as high as 34.80 mg/L since July 1975. A spill of 5,000 gallons of chloroform in 1970, 120 ft from the well, is probably the source. The chloroform is adsorbed in the unsaturated zone in the alluvium; the greatest concentrations are near the water table. Lesser amounts of carbon tetrachloride are found with the chloroform. Its source is unknown. The two contaminants were in the unsaturated alluvium until rising ground-water levels caused water to contact them and the water-chloroform mixture began moving down-gradient to the well. High river stages cause a seasonal cycle of water level rise; the raised ground water comes in contact with more chloroform and the chloroform concentration of the well water increases. No carbon tetrachloride has been observed in the well water. (USGS)
W84-01030

QUALITY OF WATER IN LUXAPALLILA CREEK AT COLUMBUS, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
USGS Open-File Report 82-373, 1982. 38 p, 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Water quality, *Mississippi, Surface waters, Low flow, Metals, Luxapallila Creek, Columbus, Lowndes County.

The results of a water quality study of a short reach of Luxapallila Creek at Columbus, Mississippi, during September 9-12, 1979, indicate that the water is colored (60 units) and has a low dissolved solids content (44 mg/L). The dissolved oxygen concentration, temperature, and pH of the water in Luxapallila Creek changed a slightly downstream through the study reach. The mean specific conductance almost doubled and the five-day biochemical oxygen demand load increased over four times through the study reach. The fecal coliform to fecal streptococcus ration of 3 to 5 samples collected at the downstream site was greater than 4.0, strongly suggesting the presence of human waste. The concentrations of iron and manganese at the downstream site exceeded the U.S. Environmental Protection Agency's criteria for domestic water supplies. High concentrations of iron, manganese, and lead also were present in a bottom material sample at the downstream site. (USGS)
W84-01034

QUALITY OF WATER AND TIME OF TRAVEL IN BAKERS CREEK NEAR CLINTON, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
USGS Open-File Report 82-427, 1982. 37 p, 9 Fig, 2 Tab, 5 Ref.

Descriptors: *Water quality, *Mississippi, Surface waters, Low flow, Dissolved oxygen, Bakers Creek, Lindsey Creek, Clinton, Hinds County.

Although dissolved-oxygen concentrations remained below 5 milligrams per liter, the water quality in Bakers Creek improved in a 1.8 mile reach downstream of a (source of) wastewater outfall. The mean specific conductance decreased from 670 micromhos per centimeter to 306 micromhos per centimeter. The 5-day biochemical oxygen demand decreased from 19 to 2.8 milligrams per liter. The mean total nitrogen and phosphorus concentrations decreased from 10 to 7.1 milligrams per liter to 1.0 and 0.87 milligrams per liter, respectively. Maximum fecal coliform bacteria decreased from 7200 to 400 colonies per 100 milliliters. The concentrations of mercury (0.4 micrograms per liter), iron (3,400 micrograms per liter) and manganese (1,100 micrograms per liter) at the downstream site contained DDD (2.5 micrograms per kilogram), DDE (2.7 micrograms per kilogram), and DDT (.3 micrograms per kilogram). The average rate of travel through a 1.8-mile reach of Bakers Creek was 0.06 foot per second or 0.04 mile per hour. (USGS)
W84-01035

WATER QUALITY OF THE UPPER VERMILION RIVER, LOUISIANA, APRIL-AUGUST 1980,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. K. Demcheck, and H. L. Leone, Jr.
Louisiana Department of Transportation and Development, Baton Rouge, Water Resources Technical Report No 30, 1983. 37 p, 8 Fig, 9 Tab, 17 Ref.

Descriptors: Water quality, *Dissolved oxygen, Biochemical oxygen demand, *Conductivity, Trace metals, Ions, Pesticides, Enteric bacteria, *Productivity, Phytoplankton, Benthic fauna, Streamflow, *Louisiana, Upper Vermilion River, Lafayette, Water-quality differences, Bayou Teche.

Analyses of water-quality data collected during 1980 in a reach of the Vermilion River from its headwaters to a point 6 miles downstream from Lafayette, La., indicate that non-point runoff from the upper basin is a major factor in depressed dissolved-oxygen concentrations, high biochemical oxygen demand, and elevated fecal-bacteria concentrations. High flows masked the contributions of point and nonpoint sources in the Lafayette urban area. When flow lessened, waste inputs from the urban area degraded the water quality in the stagnant reach downstream from Lafayette, primarily through accumulations of nutrients, organic carbon, and biochemical oxygen demand. Changes in benthic macroinvertebrate populations and in algal dominance downstream from Lafayette suggest that discharges in the area have a detrimental impact on the already poor water quality of the Vermilion River during periods of low or zero flow. Samples were collected on an event basis from April through August 1980 and analyzed for inorganics, metals, pesticides and other organic compounds, nutrients, biochemical oxygen demand, fecal bacteria, phytoplankton, and benthic invertebrates. (USGS)
W84-01046

5C. Effects Of Pollution

A SURVEY OF THE MUSSEL DENSITIES IN POOL 10 OF THE UPPER MISSISSIPPI RIVER,
Wisconsin Dept. of Natural Resources, Madison.
R. E. Duncan, and P. A. Thiel.
Technical Bulletin No 139, 1983. 14 p, 4 Fig, 2 Tab.

Descriptors: *Mussels, *Water pollution effects, *On-site data collections, *Shellfish, *Wildlife habitats, *Navigable rivers, River beds, Rivers, Water quality, Habitats, Reservoirs, Data collections, *Wisconsin, Mississippi River.

Impoundment, water quality, and other factors have had an impact on the mussel fauna of the Upper Mississippi River. The primary objective of this survey was to quantitatively define the diversity and relative density of the mussel community in Pool 10 of the river. Pool 10 extends from Lock and Dam No. 9 near Lynxville, Wisconsin, to Lock and Dam No. 10 at Guttenberg, Iowa, a total of 32.8 river miles. Of the 309 sites sampled, mussels were found at 224 sites, or 72%. The East Channel near Prairie du Chien, Wisconsin had the richest mussel fauna with an average density of 2.964 mussels per square foot; and only 6% of the sites were nonproductive. The lower end of Pool 10 had the lowest mussel density at 0.655 per square foot and the highest percentage of nonproductive sites, 38%. The mussel density in the main channel border was two times greater than in the main channel and backwater. A total of 12,150 live specimens representing 31 species of freshwater mussels were collected from Pool 10; an additional 7 species were represented only by dead specimens. Threeridge, Amblema plicata, was by far the most abundant mussel species, comprising 52.9% of the catch and having an average density of 0.832 per square foot. (Garrison-Omniplan)
W84-00909

RECONNAISSANCE OF STORMWATER-RUNOFF WATER QUALITY OF THE BIG PINEY CREEK SEGMENT OF THE CEDAR-PINEY WATERSHED, YELL COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-00933

COMPUTER SIMULATION OF PHOSPHORUS CYCLING IN THE SEDIMENT-WATER SYSTEM OF EUTROPHIC LAKES,
Maine Univ. at Orono. Dept. of Mathematics.
For primary bibliographic entry see Field 2H.
W84-00964

SITE STUDIES OF DETERMINE THE EXTENT AND POTENTIAL IMPACT OF HERBICIDE CONTAMINATION IN KANSAS WATERS,
Kansas State Univ., Manhattan. Dept. of Systematics and Ecology.
For primary bibliographic entry see Field 5B.
W84-00970

HYDROLOGY, WATER QUALITY, AND BIOLOGY OF BAPTISTE COLLETTE BAYOU IN RELATION TO THE MISSISSIPPI RIVER AT VENICE, LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-01025

WATER QUALITY OF THE UPPER VERMILION RIVER, LOUISIANA, APRIL-AUGUST 1980,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-01046

5D. Waste Treatment Processes

CLOSED CYCLE TEXTILE DYEING:FULL SCALE RENOVATION OF HOT WASH WATER BY HYPERFILTRATION,
Carre, Inc., Seneca, SC.
For primary bibliographic entry see Field 3A.
W84-00749

ADVANCED TREATMENT OF SECONDARY SEWAGE EFFLUENT BY MEMBRANE PROCESS,
Water Re-Use Promotion Center, Tokyo (Japan).
G. Inoue, H. Ogasawara, C. Yanagi, and Y. Murayama.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 423-434, 7 Fig, 7 Tab, (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: *Reverse osmosis, *Ultrafiltration, Pretreatment, Sewage effluent, Wastewater treatment, *Advanced wastewater treatment, Tertiary wastewater treatment.

The experimental results on advanced treatment of secondary sewage effluent by ultrafiltration (UF) and reverse osmosis (RO) are presented, particularly focused on pretreatment system, operating condition, membrane cleaning system, and product water quality.
W84-00760

HEALTH AND SAFETY ASPECTS OF IRRIGATION OF RAW-EATEN FOOD CROPS WITH REUSED WATER,
Engineering-Science, Inc., Berkeley, CA.
B. Sheikh, P. N. Storrs, J. Jones, J. S. Hsiao, and W. R. Kirkpatrick.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 491-502, 7 Fig, 1 Tab, (Comprising 2nd Vol. Proc. of Int. Congress on Desalination and Water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: Safety, *Land disposal, *Wastewater irrigation, Wastewater forming, Reclaimed water, Wastewater disposal, Municipal wastes, Monterey, Irrigation, California.

The Monterey Wastewater Reclamation Study for Agriculture (MWRSA) has completed its first year of a five-year pilot effort to investigate and to demonstrate feasibility of food crop irrigation with reclaimed municipal effluent. The project comprises a 96-plot field trial for statistical comparison of three water treatments; an eight-hectare commercial scale farm for demonstration of water reclamation for growing lettuce, broccoli, cauliflower, celery, and artichokes; and aerosol study, a virus assay, market studies, and other ancillary investigations. First year results preliminarily indicate that the main hypothesis of the study will prove to be true, i.e. 'raw-eaten food crops irrigated with properly treated municipal wastewater effluent are safe for human consumption'.
W84-00767

ADVANCE IN WATER QUALITY MONITORING AND THE USE OF FIREFLY LUCIFERINE/LUCIFERASE ATP BIOASSAY,
Science Applications, Inc., La Jolla, CA.
N. Malley, and D. L. Henry.
Desalination, Vol 39, Nos 1/2/3, December 1981, p 521-528, 3 Fig, 6 Ref. (Comprising 2nd Vol. Proceedings of Int. Congress on Desalination and water Reuse, Manama, Nov. 29-Dec. 3, 1981).

Descriptors: Desalination, Water treatment, *Wastewater reuse, *Drinking water, Potable water, Bacterial analysis, Firefly luciferien/luciferase, Adenosine triphosphate, *Bioassay.

Recent advances in rapid clinical bacterial quantification in urine have encouraged the development of automated live-time bacterial level monitoring in drinking water and in recycled/reused wastewater. The methodology and instrumentation used in the bacterial ATP determination, were evaluated. Under appropriate assay conditions there is a linear correlation between ATP
and live bacteria. The common indicator,
ever live bacteria is being measured is the re
ble respiratory metabolite, Adenosine T
phate (ATP), as measured in g/ml per ce
fecal E. coli = 500,000,000 mu g/cell) th
counted as a bacterial pool indicator lab
biomass. When this information was couplec
oxygen uptake rate (automated ionic senso
detector in 60 minutes), the biological
demand (BOD) could be calculated as: B
(Constant) (Oxygen Uptake Rate) over (Bi
W84-00769

CHEMISTRY AND APPLICATION OF O AND OZONE/UV LIGHT FOR W REUSE-II,
Westgate Research Corp., Los Angeles, CA
E. Leitis, J. D. Zeff, and M. M. Smith.
Available from the National Technical Infor
Service, Springfield, VA 22161 as PB84-
Price codes: A09 in paper copy, A01 in mic
Report OWR/RU-83/5, June 1983. U.S. D
the Interior, Bur. of Reclamation, Wash
DC. 155 p, 36 Fig, 40 Tab, 77 Ref, 1 A
OWRT C-00256-R(No 1436)(1), OWRT
0001-1436.

Descriptors: UV light, Ozone, UV-ozo
mechanism, Aqueous C-Cl Bond Breaking,
tion, Compounds, Degradation, Chlorine
pounds, Heavy metal ions, Refractory or
*Water reuse, Wastewater treatment, Ecot
Advanced wastewater treatment, Industria
ent reuse.

This report describes the continuation of an
mental study to elucidate the chemistry of
violet light (UV) enhancement of ozone (O
oxidation of refractory organics in wast
The overall purpose of this study is to redu
fixed and operating costs of removing the
stituents prior to water reuse. The study co
of (1) an investigation of the synergistic ef
ozone and wavelength of UV light in br
carbon-chlorine bonds (2) evaluation of th
ozonation process to oxidize amino compou
survey of heavy metal ion interference in th
ozonation system and (4) accumulation o
from bench and pilot plant tests on industria
ent from a chlorophenol plant in the Nort
The more important experimental findings s
that (1) 254 nm UV light, having a minor
component, was superior to 254 nm UV l
enhancing both the rates of carbon chlorin
breaking and the yield of chloride ions durin
ozonation of several classes of chlorinated al
model compounds. (2) The pathway of the
group nitrogen in aromatic amines leading
trate ions was outlined and the rates of the
pearance of these amines during ozonatio
UV-ozonation estimated. (3) The conditi
heavy metal ion interference in UV-ozo
were ascertained and (4) data from pilot
experiments were used to calculate the fixe
and the operating costs for a full scale wast
treatment plant.
W84-00962

5E. Ultimate Disposal Of Wast

WATER-QUALITY RECONNAISANCE O NORTH DATA COUNTY SOLID-WASTE POSAL FACILITY, FLORIDA,
Geological Survey, Tallahassee, FL. Wat
sources Div.
For primary bibliographic entry see Field 5B
W84-00874

GEOLOGIC AND WELL-CONSTRUC DATA FOR THE H-10 BOREHOLE COM NEAR THE PROPOSED WASTE ISOLA PILOT PLANT SITE, SOUTHEASTERN MEXICO,
Geological Survey, Albuquerque, NM. Wat
sources Div.
J. G. Wells, and S. L. Drellack, Jr.
USGS Water-Resources Investigations Rep
4124, 1983. 34 p, 3 Fig, 7 Tab, 11 Ref.

tors: Cores, *Boreholes, Geologic units, ctive waste disposal, Drillers logs, *Waste n Pilot Plant, *New Mexico, Eddy County.

10 borehole complex, a group of three spaced boreholes, is located 3 1/2 miles st of the proposed Waste Isolation Pilot ite in west-central Lea County, New The geological data presented in this re part of a site-characterization study for ible storage of defense-associated radioac- stes within salt beds of the Salado Forma- Permian age. Each borehole was designated trate a distinct water-bearing zone: H-10a pth 1,318 feet) was completed just below genta Dolomite Member of the Rustler on of Permian age; H-10b (total depth et) was completed just below the Culebra e Member of the Rustler Formation; and (total depth 1,538 feet) was completed he Rustler Formation-Salado Formation The geologic units penetrated in borehole re surficial alluvium and eolian sand of e age (0-5 feet); the Mescalero caliche (5-9 l the Gatuna Formation (9-90 feet) of Pleis- age; formation in the Dockum Group Formation, 90-482 feet and Santa Rosa e, 482-658 feet) of Late Triassic age; and vey Lake Red Beds (658-1,204 feet), the Formation (1,204-1,501 feet), and part of do Formation (1,501-1,538 feet), all of Per- e. The sections of the Rustler and Salado ons penetrated by borehole H-10c are e and contain little or no evidence of disso- halite and associated rocks, indicating that ward-moving dissolution on top of the found just to the west of the WIPP site, eached the H-10 site. (USGS) 01

ON SUBSURFACE STORAGE OF WASTE NEAR PENSACOLA, FLOR- 3-1980,
al Survey, Tallahassee, FL. Water Re- Div.
ary bibliographic entry see Field 7C. 51

LOGIC EFFECTS OF STORING LI- D SEWAGE SLUDGE ON STRIP- LAND IN FULTON COUNTY, ILLI-
al Survey, Urbana, IL. Water Resources
terson.
from the OFSS, USGS, Lakewood, CO rice: $4.25 in paper copy, $3.50 in micro- SGS Water Resources Investigations 2-4047, December 1982. 30 p, 11 Fig, 10 f.

rs: *Groundwater, *Water quality, sludge, *Reclamation, Strip mines, Hy- models, Water table, Settling basins, isposal, Fulton County, *Illinois, Sludge

r table near four sewage storage basins in ined area of western Illinois, has risen feet since the basins were constructed in o dimensional modeling of ground-water he mine spoil indicates that the rise is y leakage from one storage basin. The c-parameter values producing the best fit computed and observed head values are feet per second for the hydraulic conduc- the mine spoil, 0.0000000004 feet per r recharge from the leaking basin. The licates the volume of water leaking from is 91,600 cubic yards per year. The prin- ponents of the sewage sludge after the e been removed are alkalinity, nitrogen, ous, and chloride. Components in higher tions near the basins were sodium, alka- l chloride. Because the sodium and chlo- entrations in the sludge were too low to higher concentrations in the ground strip-mine spoil used in constructing the s considered to be the major source of stituents. This spoil has been moved from l location and unweathered surfaces ex- posed, which allowed dissolution of carbonate and chloride and release of sodium through cation exchange. (USGS)
W84-00977

5F. Water Treatment and Quality Alteration

REMOVING URANIUM FROM DRINKING WATER SUPPLIES: DEMONSTRATION OF SELECTED ION EXCHANGE AND CHEMICAL CLARIFICATION,
New Mexico State Univ., Las Cruces. Dept. of Chemical Engineering.
D. B. Wilson.
Proceedings of Twenty-eighth Annual New Mexico Conference, 'Water Quality in New Mexico,' April 5-6, 1983. WRRI Report No 169, New Mexico Water Resources Research Institute, Las Cruces, June 1983. p 193-206, 4 Fig, 6 Tab.

Descriptors: *Uranium, *Water quality standards, *Radioactive wastes, *Ion exchange, *Chemical coagulation, *Chemical flocculation, *Sedimentation, *Filtration, Flotation, Surveys, Water policy, Water resources institutes, Federal jurisdiction.

The proposed standard for uranium has been suggested as 10pCi/l (equivalent to 14.7 micrograms/l). Before establishing this standard, the U.S. Environmental Protection Agency must demonstrate available economical control technology for achieving such a level. This study is being conducted to demonstrate ion exchange and chemical clarification technology. Chemical clarification consists of coagulation, flocculation, and solid-liquid separation, such as sedimentation, flotation and/or filtration. While the mechanism of uranium removal via chemical clarification has not been proved conclusively, it most likely occurs through the adsorption of the uranyl ion complex by the coagulant precipitate. Conventional water treating systems which use chemical clarification employ either rapid-mix basins, flash-mix basins, or in-line mixers. Ion exchange is a separation process in which ions held by electrostatic forces to charged functional groups on the surface of an insoluble solid are replaced by ions of like charge in solution. Ion exchange has been used as a standard unit operation for the commercial recovery of uranium for many years. Graduate students in chemical and civil engineering are assembling the equipment for the chemical clarification evaluation experiments, and the ion exchange equipment is already operating on location. (Garrison-Omniplan)
W84-00857

REMOVAL OF REFRACTORY ORGANICS FROM WATER BY AERATION. II. SOLVENT SUBLATION OF METHYLENE BLUE AND METHYL ORANGE,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
J. L. Womack, J. C. Lichter, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 7, p 897-924, May, 1982. 17 Fig, 18 Ref.

Descriptors: *Separation techniques, *Organic compounds, *Surfactants, *Organic solvents, *Dyes, Theoretical analysis, Pollutant identification, Drinking water, Water analysis, Salts, Solvents, Water treatment.

In solvent sublation, a surface-active solute is transported from the aqueous phase to an overlying layer of a nonvolatile organic liquid on the air-water interfaces of bubbles rising through the solvent sublation cell. This technique has been suggested for removing dissolved substances from aqueous systems. The removal of the refractory organics methylene blue-sodium tetradecylsulfate and methyl orange-hexadecyl-trimethylammonium bromide from water to 2-octanol was carried out by solvent sublation. Three possible mechanisms were examined in the laboratory batch scale experiments. Potassium chloride, sodium nitrate and sodium biphosphate were tried as added salts. The colored species removed for each refractory compound is believed to consist of one ion of dye complexed with two of surfactant. The effects of mass transfer rate in the vicinity of the bubble-water interface were examined theoretically. The empirical time constant for mass transfer was related to the lowest eigenvalue of an appropriate diffusion problem. (Geiger-FRC)
W84-00954

5G. Water Quality Control

THE STATE WATER PLAN, SUBBASIN 17, CENTRAL ALLEGHENY RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6D.
W84-00784

THE STATE WATER PLAN, SUBBASIN 18, LOWER ALLEGHENY RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 5B.
W84-00786

MORRIS COUNTY MASTER PLAN: WATER SUPPLY ELEMENT.
Killman (Elston T.) Associates, Inc., Millburn, NJ.
For primary bibliographic entry see Field 6D.
W84-00788

STATE WATER PLAN: SUBBASIN 5, UPPER CENTRAL SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00848

STATE WATER PLAN: SUBBASIN 4, UPPER SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00849

STATE WATER PLAN: SUBBASIN 1, UPPER DELAWARE RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 6B.
W84-00850

POINT SOURCE WASTE LOAD ALLOCATION FOR THE TOWN OF RED RIVER,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
D. F. Tague.
Proceedings of Twenty-eighth Annual New Mexico Conference, 'Water Quality in New Mexico,' April 5-6, 1983. New Mexico Water Resources Institute, Las Cruces, June 1983. p 12-21, 4 Fig, 3 Tab, 1 Ref.

Descriptors: *Waste load, Tertiary wastewater treatment, *Water quality standards, *Water quality criteria, *Surveys, *Water use, Nonpoint pollution sources, *Phosphorus, Stream discharge, Algal growth, Economic aspects, *Wastewater treatment, Secondary wastewater treatment, *New Mexico, Red River.

A point source waste load allocation for municipal discharge was required for the Red River in New Mexico when secondary treatment was not sufficient to meet water quality standards. First, the designated uses were identified and numeric or narrative criteria were determined that were sufficient to preserve the designated uses. A year-long stream and effluent sampling program was conducted. A series of 11 algal assay tests demonstrated that the Red River is a phosphorus-limited aquatic environment. Consequently, the river is exempt from the total inorganic nitrogen standard and a waste load allocation is not required for that constituent. The stream standard for total phosphorus (P) was exceeded on 15 of 21 sampling dates at the station below the treatment works. No other

violations of stream standards were observed at this station. At Station HRG-21, six miles above the town, where the natural quality of the river is represented, the average P concentration is 0.006 mg/liter. Cultural nonpoint sources in and above the town add phosphorus sufficient to raise the river concentration to 0.022 mg/liter, an increase of 3.67 times. Monthly phosphorus limitations were developed that take into account monthly low streamflow and seasonal variations in wastewater flow. The savings in costs of operation to the town of Red River that will result from wastewater treatment requirements for phosphorus and ammonia developed on a seasonal schedule was estimated at more than $200,000 per year. (Garrison-Omniplan)
W84-00855

NONPOINT SOURCES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 6B.
W84-00916

6

INDUSTRIAL WASTEWATER,
Texas Univ. at Austin. Dept. of Environmental Engineering.
G. A. Rohlich.
In: Proceedings of the National Water Conference, Water Quality and The Clean Water Act, Philadelphia, January 26 and 27, 1982. Academy of Natural Sciences, Philadelphia, July 1982. p 67-86, 8 Fig, 3 Tab, 9 Ref.

Descriptors: *Industrial wastes, *Manufacturing wastes, *Hazardous materials, *Industrial wastewater, *Water quality standards, *Water quality control, *Industrial plants, Poisins, Industrial production, Legal aspects, Water policy, Public policy, Municipal wastes.

Despite the vast amount of information available, technical solutions to the problem of industrial waste treatment become more complex in view of the inclusion of toxic pollutants in water quality standards and effluent limitations. Data on the performance of available treatment technology for removing many of the toxic constituents is limited or non-existent. Separation of waste streams at the source should be considered so that toxic materials can be segregated and handled independently. Some difficult issues to decide are what types of plants to use, the technical and economic sufficiencies of the facilities, and justifying why a particular type was selected in terms of social and legal constraints. Progress has been made in meeting the legal requirements of the National Pollutant Discharge Elimination System (NPDES). As of February 1980, nearly 59,000 NPDES permits were issued. Of these, 15,395 were to municipalities and 43,512 to non-municipal (mostly industrial) discharges. There has been a steady decline in the number of violations by non-municipal NPDES permit holders: 184 in 1977; 121 in 1978; and 64 in 1979. In the total pollution abatement category, total annual costs in 1979 are estimated to be $7.6 billion in 1979 and $11.5 billion in 1988. Future policies and legislation must place additional emphasis on 'prophylactic rather than therapeutic measures.' (Garrison-Omniplan)
W84-00917

MUNICIPAL WASTEWATER TREATMENT: 1970 AND TODAY,
Water Pollution Control Federation, Washington, DC.
C. F. Guarino.
In: Proceedings of the National Water Conference, Water Quality and The Clean Water Act, Philadelphia, January 26 and 27, 1982. The Academy of Natural Sciences, Philadelphia, July 1982. p 51-65.

Descriptors: *Municipal wastewater, *Industrial wastes, *Municipal wastes, *Legislation, *Federal jurisdiction, *Economic aspects, *Legal aspects, *Lake rehabilitation, Lake reclamation, Wastewater treatment, Water quality standards, Water quality control.

In 1970 the President's Council on Environmental Quality (CEQ) reported our nation needed to invest $10 billion in municipal water treatment and $3.3 billion in industrial control. During that year federal appropriations for research and development in the water pollution control field were increased to $60 million. Federal aid to state programs was set at $10 million. Two significant goals set by Congress were secondary treatment for municipal wastewater treatment authorities by July 1, 1977, and 'fishable, swimmable' waters wherever attainable by July 1, 1983. To date almost $32 billion has been appropriated for the program; $18 million has been spent. Yet the goals were not universally reached. Up to two-thirds of the treatment authorities in the country missed the 1977 deadline. By the end of 1979, heavy metal concentrations were reported by CEQ as the most widespread water quality problem, and 10,000 of some 37,000 public lakes were found to be in need of restoration or pollution control. On the other hand, some clean water successes have occurred in New Hampshire, New Jersey and Texas where fish have returned to formerly polluted waters. The Water Pollution Control Federation believes the EPA needs to devote more attention to questions of performance. Meanwhile, a revision to secondary treatment regulations should be made to allow case-by-case waivers of biochemical oxygen demand and suspended solids requirements or 85% removal criteria, based on water quality justifications. (Garrison-Omniplan)
W84-00918

WHAT IS THE CONDITION OF OUR SURFACE WATER.,
Academy of Natural Sciences of Philadelphia, PA.
R. Patrick.
In: Proceedings of the National Water Conference, Water Quality and The Clean Water Act, Philadelphia, January 26 and 27, 1982. Academy of Natural Sciences, Philadelphia, July 1982. p 11-29, 11 Fig.

Descriptors: *Surface water, *Water quality control, *Water quality standards, *Stream improvement, *Stream pollution, Rivers, Water pollution, Legislation, Swimming, Wildlife habitats, Public policy, Water policy, Sediment load.

A single standard in pollution control cannot be applied throughout the United States because of variances in the natural and chemical characteristics of streams. Most of the streams in the southeastern United States have a dissolved oxygen content lower than 2 to 3 ppm. Likewise, the natural sediment load varies greatly and is particularly heavy in the midwestern and southwestern parts of the United States. Natural causes of high phosphate exist in Florida and some parts of Texas. To be meaningful, regulations should be aimed not only at swimmabiltiy and fish, but also at protecting the microorganisms and smaller macroorganisms in streams and lakes that are important in the recycling of waste and the restoring of water quality. Improvements have occurred in the Ohio River where over 100 successful bass tournaments were held in 1975, something that would never have been considered in 1970. Other improvements have been in the Delaware and Connecticut Rivers, and in streams in Maine, where about 67% were found to be fishable and swimmable. Streams in Massachusetts, Connecticut and Pennsylvania also showed improvement as of 1976. The Potomac River in Washington, D.C., is fishable near the city. Out of 642 small streams in Tennessee, 300 to 346 now meet water standards and 258 more will meet them in 1983. The majority of streams in Minnesota, Nebraska, Kansas and Arkansas will also support fish and wildlife in 1983. (Garrison-Omniplan)
W84-00919

LOCALIZED DESTRATIFICATION AT LAKE TEXOMA,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
K. M. Robinson, J. E. Garton, and R. E. Punnett.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 739-749, August, 1982. 13 Fig, 2 Tab, 12 Ref. OWRT C-7603(No 7250).

Descriptors: *Destratification, *Reservoir rel
*Mixing, *Lake Texoma, *Oklahoma, *
Water quality management, Intakes, Hypolim
Epilimnion, Metalimnion, Stratification, Th
stratification, Pumps, Turbidity, Sulfides, M
nese, Iron, Phosphorus, Ammonia, Lakes.

The quality of water released from ther
stratified Lake Texoma was improved by use
axial flow Garton Pump located above the
structure. The 8 ft diameter, 6-blade pro
pump, mounted on a floating platform, oper
propeller suspended 5.6 ft below the water s
to pump high quality epilimnion water down
intake. Outlet release rates were varied from
600 cfs. At the maximum dilution factor of
the pump/release rate ratio was 0.48. Max
improvements were: turbidity, 83% at 30
sulfides, 68% at 50 cfs; manganese, 49% at 1
total iron, 21% at 300 cfs; phosphorus, 53%
cfs; and ammonia-N, 37% at 150 cfs. Max
temperature increase was 3.24F at 300 cfs.
time of the study, August 18, 1980, the epili
was 52.5 ft deep and the metalimnion ext
from 52.5 to 65.5 ft. Below 59 ft the wate
anoxic. (Cassar-FRC)
W84-00956

**NITRATE LOSS FROM AGRICULTU
DRAINAGE WATERS: IMPLICATIONS
NONPOINT SOURCE CONTROL,**
North Carolina State Univ. at Raleigh. De
Soil Science.
For primary bibliographic entry see Field 5B.
W84-00965

**GRAPHICAL METHOD FOR ESTIMA
OCCURRENCE AND DURATION OF A C
CAL LOW FLOW IN THE SACRAME
RIVER AT FREEPORT, CALIFORNIA,**
Geological Survey, Menlo Park, CA. Wate
sources Div.
J. G. Harmon.
USGS Water Resources Investigations Repo
4001, May 1983. 16 p, 1 Tab, 6 Fig, 2 Ref.

Descriptors: *Effluents, Flow duration,
tides, Outfall, *Spring tides, Stages, Stream
Unsteady flow, Wastewter treatment, *Low-
Sacramento River, *California.

Sacramento County expects to begin operati
the Sacramento Regional Wastewater Trea
Plant in 1982. The California State Wate
sources Control Board has ruled that the plan
not be allowed to release effluent into the S
mento River when flow in the river is 4,000
feet per second or less. Depending on tide c
tion, flows less than 4,000 cubic feet per se
may occur either once or twice during eac
hour 50-minute tide cycle when the daily
flow is less than about 12,000 cubic fee
second. Daily means flows less than 12,000
feet per second occur about 28% of the
Riverflow at the plant outfall is monitored
acoustic streamflow-measuring system. Regul
of effluent released from the plant will norma
based on real-time flow data computed by
acoustic system. A graphical method for dete
ing the occurrence and duration of flows of
cubic feet per second and less was developed
backup system to be used if a temporary failu
the acoustic system occurs. (USGS)
W84-00973

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

**INTEGRATING INTERMITTENT AND
NEWABLE POWER RESOURCES INTO
HYDROPOWER SYSTEM OF THE PAC
NORTHWEST,**
Washington State Univ., Pullman. Dept. of C
puter Science.
C. B. Millham.
Available from the National Technical Inform
Service, Springfield, VA 22161 as PB84-14

e codes: A06 in paper copy, A01 in microfiche.
er Research Center Completion Report, July,
. 118 p, 9 Fig, 24 Tab, 28 Ref, 1 Append.
RT A-111-WASH(1), 14-34-001-2151.

riptors: *Solar water heaters, *Solar pumps,
d turbines, *Hydropower simulation, *Com-
modeling, Pumped storage, Streamflow con-
s, *Pacific Northwest U.S., Columbia River,
e River, Model studies, Auxiliary hydropower
es.

report discusses the extent to which hydro-
r could be used to 'smooth' and back up
mittent and unreliable power sources, includ-
olar water heaters, solar irrigation pumps, and
-generation turbines. The amounts of power
ved in each are developed, and economic
ations are given. Because the volumes of
r are potentially relatively large and because
economics of wind turbines are potentially
etitive, the bulk of the work focuses on these
The tool of analysis is a 51-reservoir, 56-
period computer simulation model of the hy-
ower system in the Snake and Columbia
s and tributaries.
00958

Evaluation Process

**AQUE SOUTH PROJECT ECONOMIC
SIBILITY STUDY, EXECUTIVE SUM-
Y.**
rt (Clinton) Associates, Fort Lee, NJ.
rt submitted to North Jersey District Water
y Commission, Wanaque, January 1981. 18 p,
1 Tab.

riptors: *Economic feasibility, *Feasibility
s, *Water supply development, *Construc-
costs, Drought, Computer models, Storage
rements, Watersheds, Pumping plants, Diver-
Spillway gates, Spillway crests, Capital costs,
voir sites, *New Jersey, Wanaque South
ct.

ortheastern metropolitan area of New Jersey
xperienced at least one severe drought in
decade since the turn of the century, except
1970's. The Wanaque South Project repre-
the major step to relieve the threat of a water
The Project joins the Passaic and Hacken-
watersheds for the benefit of a region without
g significant problems for any known or
d beneficial use. It may be adapted to pro-
greater yields by construction of Monksville
voir and by diversions from the Raritan,
n, or Delaware River Basins. Using comput-
deling with draft conditions, the feasibility
determined storage requirements for various
ed yields for historical droughts for two
ng periods, developed two alternative proj-
nd developed preliminary designs to permit
able estimates of construction and operating
The permissible pumping period, as deter-
by stream flow and water quality stipula-
f the grant, results in an incremental yield of
roject ranging from 79 to 64 million gallons
ay. The advantages of the Wanaque South
t over alternatives studied are in both the
able amount of the supply and the costs,
are about 40% of that for other proposed
ts per million gallons of dependable yield.
-Omniplan)
W0784

**ASINS 14 AND 16, GENESEE RIVER
UPPER ALLEGHENY RIVER,**
ylvania Dept. of Environmental Resources,
burg. Office of Resources Management.
t SWP-16, December 1980. 172 p, 19 Fig, 42
Append.

iptors: *Rivers, *Brines, *Leachates, *Water
ion control, *Biodegradation, *Suspended
*Dissolved oxygen, Water use, Petroleum
cts, Sediment yield, Municipal wastes, Indus-
wastes, Water treatment, Landfills, Wild
*Pennsylvania, Genesee River, Upper Alle-
River.

The two main water quality problems in Subbasins 14 and 16, the headwater areas of the Upper Allegheny River Basin and the Genesee River Basin, are suspended solids and biodegradable wastes, caused by inadequately treated municipal and industrial waste discharges, and degradation by oil and gas well brines. Tunungwant Creek has high BOD, ammonia, phenol, chlorides and dissolved solids. The planned upgrading of the Bradford treatment facilities will reduce the BOD and ammonia problems. Conewango Creek's main problem is organic suspended material and low dissolved oxygen values which originate upstream in the State of New York. Oil and gas brines are affecting three streams, and sewage discharges at Tionesta are affecting the Allegheny River, but this problem should be alleviated by the proposed Tionesta treatment facilities. Oil Creek has excellent water quality except in the lower two miles, which is severely degraded due to oil pollution and related petro-chemical industrial activities. Incidents of groundwater pollution have occurred as a result of oil production, landfill leachates and industrial waste lagoons. The sediment yield for Subbasins 14 and 16 is 460,000 tons per year. It is recommended that conservation measures be implemented to reduce this problem. Within the subbasin, 22 streams have been designated as candidates for the State Scenic Rivers System. Water supplies within Subbasin 16 are generally abundant, and usage is moderate--175 mgd in 1970. In Subbasin 14, there are only two water suppliers, and both have inadequate supplies to meet existing demands during a drought. (Garrison-Omniplan)
W84-00838

SUBBASIN 11, UPPER JUNIATA RIVER,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-12, January 1980. 123 p, 18 Fig, 40 Tab, 6 Append.

Descriptors: *Groundwater pollution, *Thermal pollution, *Leachates, *Municipal wastes, *Industrial wastes, *Flood frequency, *Coal mine wastes, *Acid mine drainage, *Wild rivers, Oil pollution, Sediment yield, Soil erosion, Stream pollution, *Pennsylvania, Upper Juniata River.

Subbasin 11 in Pennsylvania typifies the Southern Alleghenies, a rural and sparsely populated area. Most of the population lives in the river valleys, which are prone to damage by flooding. Municipal and industrial development has led to localized water quality problems. Ten reaches of stream are candidates for the Pennsylvania Scenic Rivers System. Water quality problems stem from municipal or industrial waste discharges, malfunctioning on-lot sewage disposal systems, landfill leachate or acid mine drainage. Coal mining occurs to the west and south of Altoona and in Watershed D, which causes acid mine drainage into four streams. The power plant located on the Frankstown Branch Juanita River at Williamsburg causes thermal pollution. However, the plant will be retired soon. On-lot sewage system malfunctions due to inadequate soils are a problem throughout the basin. Groundwater pollution is occuring from septic tanks, landfills, oil tank leaks, seepage from industrial soils. The current sediment yield is 174,000 tons per year; this could be reduced through better conservation practices. With the exception of the Williamsburg Power plant, the largest water supply usage in the basin is for public water supply. Currently 8 of the 42 suppliers would have a source yield deficiency if a drought were to occur. Seven of the companies can meet future yield deficiencies by installing meters, which should reduce the demand. Consumptive water use could be an emerging problem, if crop irrigation during dry years increases. (Garrison-Omniplan)
W84-00839

SUBBASIN 15, LAKE ERIE,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-15, December 1979. 78 p, 17 Fig, 35 Tab, 6 Append.

Descriptors: *Eutrophic lakes, *Lake soils, *Impaired water quality, *Coliforms, *Urban runoff, *Water pollution sources, *Industrial wastes, *Municipal wastes, *Anaerobic conditions, Water pollution effects, Water pollution control, Dissolved oxygen, Water quality standards, *Pennsylvania, Lake Erie.

The Lake Erie subbasin is one of two areas in Pennsylvania which drains into the Great Lakes and St. Lawrence River. Lake Erie is not only a major factor in the development of the area, but is also a major influence on the climate, making possible better agricultural production than normal for its latitude. Water supply is not a serious problem in Subbasin 15 because the lake provides essentially unlimited amounts of water. A proposed steel plant to be located beside Lake Erie on the Pennsylvania-Ohio State line will strengthen the economy of this region, which includes the manufacturing of electrical and paper products, vineyards, orchards and dairy farms. Lake Erie has had an accelerated eutrophication rate. Pollution from cities as far away as Detroit accumulate in the lake causing decreases in dissolved oxygen and enrichment of aquatic plants. Along the south shore, combined sewer overflows and urban runoff are causing high coliform counts. Correcting the sewer overflow situation should solve most of this problem. All but three of the small streams which drain directly into Lake Erie have high coliform bacteria contamination, and ammonia, iron, phosphate and pH problems due to domestic discharges, septic tank effluents, combined sewer overflows, and urban and agricultural runoff. Deep wells are not possible because of salt water problems. Contamination of groundwater is widespread due to on-lot sewage systems which were in place prior to state regulations. The soils are poorly suited for on-lot disposal. The completion of planned and under-construction treatment plants will greatly improve this overall condition. (Garrison-Omniplan)
W84-00840

STATE WATER PLAN: SUBBASIN 10, LOWER WEST BRANCH SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-11, December 1979. 132 p, 20 Fig, 42 Tab, 6 Append.

Descriptors: *River basins. *Stream pollution, *Agricultural runoff, *Septic tanks, *Septic wastewater, *Industrial waste, *Sediment yield, Fish populations, Groundwater pollution, Leachates, Erosion control, Electric power demand, Long-term planning, Recreation demand, *Pennsylvania, Lower West Branch Susquehanna River.

A series of 23 reports being published as a result of initial ivestigations and studies conducted in connection with the State Water Plan of Pennsylvania includes this area designated as Subbasin 10. Its northern half is in the Appalachian Plateau, and the southern half is in the mountainous Valley and Ridge Province. The overall basin is 66% forested with 22% in agriculture. Most of the water quality problems identified are associated with malfunctioning septic tanks and agricultural runoff. Future mining activities must be carefully controlled to prevent possible degradation. Industrial waste slugs from the Federal Penitentiary near Lewisburg have caused fish kills in Buffalo Creek. Groundwater pollution incidents have occurred as a result of landfill leachates or septic system malfunctions. The average sediment yield of 219,000 tons per year could be reduced through the use of better erosion control measures on privately owned lands. The largest single water user within the basin is the Montour electric power generating plant, which consumes approximately 12.6 mgd. Crop irrigation and public water supplies require significant amounts of water in the basin. There are 21 public water suppliers in the basin. Most of the streams are of good quality and provide good fishing, particularly Loyalsock, Lycoming and Muncy Creeks. (Garrison-Omniplan)
W84-00843

STATE WATER PLAN: SUBBASIN 9, CENTRAL WEST BRANCH SUSQUEHANNA RIVER.

Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-10, February 1980. 132 p, 20 Fig, 43 Tab, 6 Append.

Descriptors: *River basins, *Wilderness areas, *Wild rivers, *Water quality, *Stream pollution, *Acid mine drainage, *Groundwater pollution, *Flood damage, Flood control, Flood protection, Mountains, Iron, Manganese, Scenery, *Pennsylvania, West Central Branch Susquehanna River.

Subbasin 9 in Pennsylvania is roughly 85% wooded, and is set in very mountainous terrain with deep cut streams where the wilderness areas have been largely preserved. Large portions of the area are in state ownership. Subbasin 9 is described in one of 23 reports being published as a result of initial investigations and studies conducted in connection with the State Water Plan of the Commonwealth. The primary water quality problems arise from acid mine drainage and inadequately treated wastewater. Iron and manganese concentrations continue to be excessive downstream of Lock Haven and acid slugs, which reduce the pH to as low as 4.4, have occasionally occurred. There have been some instances of groundwater pollution, particularly in the limestone valleys in the lower portion of the basin. Each year, despite the small population of the area, the subbasin sustains an average of $3.7 million in damages from floods as a result of the large number of communities in the valleys. There are 35 public water suppliers of which eight do not have sufficient source capacity to meet their present needs in a drought. Also covered in the report are goals and objectives, and physical and socio-economic features. (Garrison-Omniplan)
W84-00844

STATE WATER PLAN: SUBBASIN 8, UPPER WEST BRANCH SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
For primary bibliographic entry see Field 5B.
W84-00845

STATE WATER PLAN: SUBBASIN 7, LOWER SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-8, February 1980. 267 p, 20 Fig, 44 Tab, 6 Append.

Descriptors: *River basins, *Flood control, *Water allocation, *Flood protection, *Municipal wastes, *Electric power demand, *Flood plain management, Recreation demand, Streams, Rivers, Groundwater pollution, Nonstructural alternatives, Project planning, *Pennsylvania, Lower Susquehanna River.

Subbasin 7 is a major agricultural area within Pennsylvania and has outstanding soils associated with the limestone valleys. This subbasin is described in one of 23 reports being published as a result of initial investigations and studies conducted in connection with the State Water Plan of the Commonwealth. Streams are used in this subbasin for water supply, waste water disposal, and for industrial and agricultural usages. Urban development has created many water resources problems. Flooding, which was a relatively minor problem in the past, has now become fairly frequent. It was found that very few additional projects could be economically justified, such as a flood control reservoir on Chickies Creek above Manheim or various local protection alternatives in Harrisburg. Fertilizers being used for agriculture and municipal waste discharges are causing algae to grow in many of the streams. Electric power needs are placing a heavy requirement on the Susquehanna River to cool the condensors of the electric generators. Many streams in the basin have outstanding aesthetic qualities and are suitable for fishing and boating. The quality of groundwater in Subbasin 7 is generally good to excellent except for certain limestone regions where nitrate and overall hardness problems exist. Groundwater incidents have occurred, especially from hydrocarbon pollution, which is a serious problem in the Mechanicsburg area. Other problems have been caused by landfill leachates, malfunctioning septic systems, fertilizers, and animal wastes. (Garrison-Omniplan)
W84-00846

STATE WATER PLAN: SUBBASIN 5, UPPER CENTRAL SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-6, December 1978. 168 p, 20 Fig, 40 Tab, 6 Append.

Descriptors: *Rivers, *Stream pollution, *Flood control, *State jurisdiction, *Acid mine drainage, *Coal mines, *Flood protection, Mountains, Municipal wastes, Project planning, Dam construction, Dams, Water quality standards, *Pennsylvania, Upper Central Susquehanna River.

All of Subbasin 5 is within the Appalachian Mountain Section of the Valley and Ridge Province. It includes the drainages of the Lackawanna River and the Susquehanna River from the mouth of the Lackawanna to the confluence with the West Branch Susquehanna. This report is one of 23 being published as a result of the initial investigations and studies conducted in connection with the State Water Plan of the Commonwealth of Pennsylvania. The report outlines goals and objectives, and physical features and climate of the subbasin. In addition, there are recommendations regarding flood damage reduction, water quality and supply, and outdoor recreation. Past coal mining activities have left many of the streams severely polluted with acid mine drainage. In addition, municipal wastes of degrading the streams. The most serious problem in the basin is the flooding caused by runoff from the steep mountainous terrain. With the protection provided by flood control projects now completed or under construction, the residual damages have been reduced to $5.2 million per year. Feasible and recommended dam projects include the proposed Soil Conservation Service dam, PA 665, on Nescopeck Creek in Watershed D; dam site 37-9; and channel modification projects for the communities of Moscow and Conyngham. Planned or completed acid mine drainage abatement projects are expected to improve 23 miles of the Lackawanna River. The most pressing water supply problem is within the Pennsylvania Gas and Water Company system, which services about 428,000 people. (Garrison-Omniplan)
W84-00848

STATE WATER PLAN: SUBBASIN 4, UPPER SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-5, June 1979. 146 p, 19 Fig, 41 Tab, 6 Append.

Descriptors: *River basins, *Stream pollution, *Acid mine drainage, *Industrial wastewater, *Dam construction, Project planning, Long-term planning, State jurisdiction, Flood control, Flood protection, Water pollution control, Scenery, Streams, Rivers, *Pennsylvania, Upper Susquehanna River.

Subbasin 4, which approximates the area known as the Northern Tier Region of Pennsylvania is described in one of 23 reports being published as a result of the initial investigations and studies conducted in connection with the State Water Plan of the Commonwealth of Pennsylvania. Farming had been the primary economic base of the area for many years, but it has been replaced by manufacturing. Fishing and hunting in the area is quite good. Most of the streams are of good quality, however, they tend to flood during storms and usually have low flows during droughts. It is recommended that the construction of both the Tioga-Hammond and Cowanesque Lake projects be completed as soon as possible. The potential Towanda Reservoir site should be studied further to evaluate its flood control, recreation, water supply, low flow augmentation and hydropower potential. The average annual damages in the basin would have been $5.8 million if existing projects had not been built. Eight streams in the basin have been identified as candidates for the Pennsylvania Scenic Rivers System. The Susquehanna River g
has good water quality, but gives evid
excess iron concentrations from acid mine d
upstream, as well as domestic and in
wastewater and sedimentation problems.
pollution, sedimentation and acid mine d
are the main problems on the Tioga River
use in the basin is relatively small, at 423 mg
projections of 66 mgd by 1990. (Garriso
plan)
W84-00849

**STATE WATER PLAN: SUBBASIN 1, U
DELAWARE RIVER.**
Pennsylvania Dept. of Environmental Re
Harrisburg. Office of Resources Manageme
Report SWP-2, January 1983. 157 p, 20
Tab, 6 Append.

Descriptors: *Stream pollution, *Flood
*State jurisdiction, *Rivers, *Water d
*Flood protection, *Long-term planning, S
Recreation demand, Groundwater po
Water quality management, Water policy,
sylvania, Upper Delaware River.

This is one of 23 reports being published as
of the initial investigations and studies co
in connection with the State Water Plan
Commonwealth of Pennsylvania. Subbasi
cludes all of the direct drainage into the D
River in northeast Pennsylvania above the
River. The fact that this area remains re
undeveloped has made it an ideal area fo
ational development; however, the area i
prone. All of the damage centers in Sub
have had their floodplains mapped and all
are eligible for Federal flood insurance.
Subbasin 1, 16 stream reaches have been s
as candidates for inclusion in the State
Rivers System. The total water use within
sin 1 is currently 547 mgd, of which 511
used by the Portland and Martins Creek
generating plants. There are 35 public wat
pliers in Subbasin 1. Five of these supplie
serve water in Subbasin 2, which results in
being diverted out of the subbasin. Sedime
and erosion problems in this basin are re
small. The quality of surface and groundw
the subbasin is good to excellent, but there
areas where there are significant sources o
tion. Groundwater pollution incidents ha
curred primarily as a result of landfill l
seepage and malfunctioning on-lot dispos
tems. The report lists goals and objectives
resources problems and solution alternati
well as physical features and climate of the
sin. (Garrison-Omniplan)
W84-00850

**LONG RANGE PLANS FOR HYDRO
INVESTIGATIONS,**
Geological Survey, Albuquerque, NM. Wa
sources Div.
H. L. Case, and G. E. Welder.
Proceedings of Twenty-eighth Annual
Mexico Conference, 'Water Quality in
Mexico,' April 5-6, 1983. WRRI Report N
New Mexico Water Resources Research In
Las Cruces, June 1983. p 78-109, 9 Fig, 1
Ref.

Descriptors: *Data collection, *Surveys, *
logic data, *Long-term planning, *Projec
ning, *Water quality, *Groundwater, *Ar
drogeology, *Surface-groundwater relation
mines, Public policy, Water resources in
*New Mexico.

The need for water resources information i
Mexico is constantly changing as the avail
use, and management of water changes. Obj
of the eight Hydrologic data collection p
presented include continuing to identify futu
needs; conducting an analysis of the water
ground and surface water observation net
and entering all available current and his
hydrologic data into the U.S. Geological
Data Survey and Retrieval System
STORE). Objectives of areal appraisal stud
clude evaluating the water resources in the

nts-Zuni-Acoma sag area and on the western of the Sandia and Manzano mountains in alillo County. Potential projects for basin as-ents include quantifying the ground water/ce water relationships on rivers with flow rned by compacts, and an investigation of the r resources of the Estancia basin. Projects that assist in the evaluation of energy-related activ-include describing the effects of resaturation al mines and of milling operations on the ty and quantity of ground and waters. Activi-hat need to be undertaken to deal with waste sal problems include the evaluation of the logic factors at the Albuquerque South y 'superfund' site and the establishment of a toring network at the Waste Isolation Pilot near Carlsbad. (Garrison-Omniplan)
00852

BOR MANAGEMENT STRATEGIES FOR ENGLAND,
England River Basins Commission, Boston,

Richmond.
rt, September 1981. 48 p, 3 Fig.

riptors: *Harbors, *Management planning, g-range planning, *Interagency cooperation, er policy, *Public policy, *Public access, prehensive planning, Nonstructural alterna-Multiobjective planning, Projections, Coastal management, Area redevelopment, *New and, Northeast U.S.

England harbors possess numerous physical raints to development. The most significant of are a limited land and water base, the high of capital improvements to existing infrastruc-the predominance of private ownership, and resence of many non-water dependent long-uses. In addition, New England's harbor com-ies are limited in their abilities to successfully ve harbor use conflicts because of fragmented r planning, management, and regulations; of a common goal shared by local harbor sts; and lack of legal agreement on the nature public's interest in harbor resources. Unlike Coast states, New England states lack a g legal tradition of fully protecting the pub-interest in harbor resources. New England r communities should establish local harbor gement structures that include both an institu-vith equitable representation from all relevant ictions and public and private interest groups; plan that allocates limited harbor shoreline arbor waters among competing users. Such a ure could range from an informal networking isting agencies and interest groups with a ion set of goals, to a formalized harbor gov-ent with broad planning, management, financ-and regulatory authorities. (Garrison-Omni-
00907

SPECTS AND STRATEGIES FOR NEW LAND PORTS.
England River Basins Commission, Boston,

rt, September 1981. 68 p, 13 Fig, 7 Tab.

riptors: *Port facilities, *Regional planning, agement planning, *Waterfront facilities, authorities, *Long-range planning, Multiob-e planning, Profit, Property rights, Harbors, omic evaluation, Economic yield, *New Eng-Northeast U.S.

ughout the decade of the 1970s, New England nued to rely heavily on waterborne trade: 80 million tons of cargo annually passed gh the region's 10 major commercial ports. oximately 92% of this waterborne commerce sted of petroleum and petroleum products. direction of trade flows was predominantly nd, as receipts comprised over 90% of total tonnage. Approximately 20% of the total ne of regional waterborne trade has been han-through common-user marine terminals. The nes of cargo shipped through New England's ion-user facilities have remained relatively over the past 15 years and are not projected to grow as rapidly as is trade throughout the South and West. New England's 10 major common-user ports are administered by a variety of port organizations. The region is characterized by one port: the Massachusetts Port Authority, which is substantially more sophisticated in operations than its neighboring ports. Additionally, the New England region is unique in containing four privately-owned common-user facilities. With few exceptions, New England port organizations have minimal marketing and planning capabilities. The majority of New England port facilities have emphasized the capability to handle a variety of neo-bulk (lumber, steel) and bulk (salt, scrap metal) cargoes. While some common-user facilities operate at near capacity, an equal number of facilities operate with excess cargo-handling capacity. (Garrison-Omniplan)
W84-00908

REPORT ON REVIEW OF WATER SUPPLY PLANNING, RECOMMENDATIONS AND STRATEGY FOR WESTERN CONNECTICUT.
Anderson-Nichols and Co., Inc., Newington, CT.
Report prepared for the Western Connecticut Water Supply Council, July 1983. 66 p, 4 Append.

Descriptors: *Water yield, *Safe yield, *Water deficit, *Pipelines, *Potential water supply, *Interagency cooperation, Water supply development, Potential water supply, Yield, Water scarcity, Government interrelations, Water policy, Public policy, Longrange planning, *Connecticut.

The goals of this study were to review the water supply plan for Western Connecticut and to assess available water supply alternatives, institutional issues, small water company issues and data adequacy. A review of safe yields for the existing water supplies in Western Connecticut revealed a continuing inconsistency and inaccuracy of reported safe yields. The utilities project a year 2000 deficit of 5.2 mgd for southern Fairfield County alone, while the Corps of Engineers projects a total deficit of 5.0 mgd for 5 of 13 communities in the entire region for this year. Both the short-term and long-term water supply plans evaluated in the Housatonic River Basin Urban Study on a local and regional basis have legal, financial, institutional, or environmental barriers to implementation. The issues of water policy, legal and legislative needs as well as the issue of Class 'B' waters must be resolved first, in order to properly and thoroughly evaluate water supply plans. Several interconnections are viable alternatives, including a major interconnection between Bridgeport Hydraulic and adjoining communities in southern Fairfield County. This pipeline offers a viable solution to the water supply problems of the area. An analysis was conducted of regional water authorities, and a statewide water supply master plan is suggested. Regarding take-overs of small water companies, greater reliance should be placed on providing financial incentives rather than using state action. (Garrison-Omniplan)
W84-00911

NONPOINT SOURCES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
M. G. Wolman, and C. E. Chamberlin.
In: Proceedings of the National Water Conference, Water Quality and The Clean Water Act, Philadelphia, Janary 26 and 27, 1982. Academy of Natural Sciences, Philadelphia, July 1982. p 87-100, 16 Ref.

Descriptors: *Nonpoint pollution sources, *Pollution load, *Water pollution sources, *Water pollution effects, *Chemical wastes, *Pesticide toxicity, Water quality, Water quality data, Cost-benefit analysis, Public policy, Water policy, Water quality standards.

Pollutant discharges from both point and nonpoint sources affect the quality of rivers, lakes, estuaries, and ocean shorelines. In 1976 it was reported that after projected reductions of a variety of pollutants such as ultimate BOD, nitrogen, phosphorus, coliforms and several metals, in accord with requirements for BPT and secondary treatment by 1977, substantial loadings would remain for such pollutants as total nitrogen, phosphorus, and fecal coliforms. It was estimated that even after elimination of discharge, 79% of nitrogen, 53% of total phosphorous, 99% of coliforms, but only 11% of oil and grease would remain. The diversity of human activities and natural background across the country results in markedly different sources and characteristics of pollutants, with the result that uniform approaches will not achieve desired objectives. In general, it has been found that the organic content expressed as BOD and COD of runoff and discharges are generally comparable to concentrations found in effluents from secondary sewage treatment plants. Unit yields of sediment from construction sites may exceed previous background values 10 to 50-fold with concentrations on the order of 10,000 mg/1. For planning purposes, models are needed to compare the relative values of expenditures for control of diverse sources of pollutants to achieve given uses. (Garrison-Omniplan)
W84-00916

THE ECONOMIC VALUE OF GROUND WATER RECHARGE FOR IRRIGATION USE,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4B.
W84-00957

6D. Water Demand

DETERMINATION OF IRRIGATION PUMPAGE IN PARTS OF KEARNY AND FINNEY COUNTIES, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
R. J. Lindgren.
USGS Water-Resources Investigations 82-4011, 1982. 26 p, 141 Fig, 2 Tab, 6 Ref.

Descriptors: *Irrigation requirements, *Pumpage, *Soil moisture, Wilting point, Field capacity, Water demand, Evapotranspiration, Consumptive use, Kearny County, Finney County, *Kansas.

Irrigation pumpage was determined for parts of Kearny and Finney Counties in Southwestern Kansas using crop-acreage data and consumptive, irrigation-water requirements. Irrigated acreages for 1974-80 were compiled for wheat, grain sorghum, corn, and alfalfa using records from the U.S. Agricultural Stabilization and Conservation Service. Consumptive-irrigation requirements were computed using a soil-moisture model. The model tabulated monthly soil-moisture and crop-water demand for various crops and computed the volume of irrigation water needed to maintain the available moisture at 50% for loamy soils or at 60% for sandy soils. Irrigated acres in the study area increased from 265,000 acres during 1974 to 321,000 acres during 1980. Irrigation pumpage increased from 584,000 acre-feet during 1974 to 738,000 acre-feet during 1980. Decreased consumptive-irrigation requirements during 1979 resulted in a comparatively small irrigation-pumpage estimate of 458,000 acre-feet. (USGS)
W84-00772

THE STATE WATER PLAN, SUBBASIN 17, CENTRAL ALLEGHENY RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-17, December 1980. 146 p, 21 Fig, 48 Tab, 6 Append.

Descriptors: *Groundwater movement, *Groundwater potential, Groundwater availability, *Aquifer characteristics, *Acid mine drainage, *Strip mine wastes, *Surface water, Groundwater level, Aquifers, Mine wastes, Fuel, Industrial wastes, Coal mine wastes, Gasoline, Oil pollution, *Pennsylvania, Allegheny River.

The rugged terrain of the Appalachian Plateaus Province characterizes Subbasin 17 in Pennsylvania, where roughly two-thirds of the land is forested and one-sixth is in agriculture. The area's economy is largely based on its minerals. Coal, gas and

oil have been mined heavily in the past; coal is the major mineral resource being mined today. Abandoned coal mines, both deep and strip, as well as abandoned oil wells and gas wells are responsible for the degradation of many streams by acidity and iron. The scenic streams in the rugged terrain are valuable resources that have been despoiled by pollution. The quality of fishing in most of the streams is generally low. While the surface waters in the basin are largely polluted by acid mine drainage, the groundwaters are generally good. The exception occurs in the Claron County area where previous mining activities and inter-connected abandoned gas wells have caused widespread groundwater pollution. Water quality problems of Subbasin 17 are being examined and water quality standards and wastewater treatment plans are being developed. The heaviest water use in the subbasin occurs in the southern portion, which has two existing electric power stations, and 77 mgd of self-supplied industrial water use. These uses alone account for 312 mgd out of a total of 368 within the basin. Consumptive water use in the subbasin currently is 30 mgd and is projected to increase to 64 in 1990. It is recommended that low head hydropower studies be conducted in this subbasin. There are 56 public water suppliers in the basin, of which 48 have developed their own sources of supply. (Garrison-Omniplan)
W84-00784

THE STATE WATER PLAN, SUBBASIN 19, MONONGAHELA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-19, July 1982. 175 p, 21 Fig, 48 Tab, 6 Append.

Descriptors: *Stream pollution, *Stream improvement, *Rivers, *Coal mine wastes, *Waste pollution control, *Water quality control, *Water pollution sources, Steel industry, Industrial wastes, Acid mine drainage, Sewers, Surface water, *Pennsylvania, Monogahela River.

The abundance of coal and associated mining activities have created a serious water quality problem in the Monongahela River in Pennsylvania. It has also indirectly led to a water supply problem in the basin because of the concentration of steel and related industries, as well as power generation facilities whose daily water use totals over three billion gallons. The overall problems of the subbasin point to the particularly serious need for the construction of the Rowlesburg Reservoir on the Cheat River in West Virginia. Many alternatives have been explored but this is the only project which offers a viable solution to all of the problems which exist on this river. Although mine acids have been significantly reduced, concentrations of total dissolved solids and sulfates during low flow periods occasionally exceed the acceptable standards of 500 mg/l and 250 mg/l in the river by more than 75%. An examination of the tremendous costs involved in treating these pollutants points to the only feasible economic solution: streamflow augmentation. By releasing water for storage during low flows, pollutants would be diluted to acceptable standards. Other water quality problems which have been identified in this area include urban stream drainage, including combined sewer flows; various of nonpoint sources; thermal pollution; landfill leachate; and excessive mineral constituent concentrations in surface and groundwaters. The most critical water supply problem is the conflict between the water supply uses of the river during low flow periods and the use of the river for commercial navigation. (Garrison-Omniplan)
W84-00785

MORRIS COUNTY MASTER PLAN: WATER SUPPLY ELEMENT.
Killman (Elston T.) Associates, Inc., Millburn, NJ.
Report submitted to the Morris County Planning Board, N.J., October 1982. 94 p, 7 Tab, 16 Ref, 4 Append, 4 Plates.

Descriptors: *Long-term planning, *Water supply, *Water demand, *Water supply development, *Alternative planning, Administrative regulations, Water costs, Areal hydrogeology, Groundwater, Water quality, Groundwater pollution, Wells, Chemical analyses, Regional planning, Aquifers, *New Jersey, Morris County.

The recent drought and water supply shortage which affected northern New Jersey has illustrated the need for ample water supply reserves and long range planning. The study examines these issues and presents recommendations which would improve the quality and reliability of water supply services in Morris County. Water supplies are ample and are derived from both surface and groundwater sources, with groundwater accounting for the greatest percentage of water consumed. This report highlights the County's dependence on its subsurface aquifers, locates them, and forms a starting point from which local municipalities can take steps to further protect their drinking water supplies. The study analyzes water supply sources, facilities, consumption patterns, and future needs. Extensive development and diversion of surface water out of the County has reduced available supplies. In recent years, episodes of groundwater contamination have jeopardized or closed several municipal supplies. Responsibility for management and distribution of potable water in Morris County is vested in numerous independent water companies, both public and private. Thus, implementation of long-term water supply management strategies can be difficult. This report defines the role of the Morris County Municipal Utilities Authority in overcoming that problem. (Fazio-Omniplan)
W84-00788

THE BENCHMARK FARM PROGRAM-- A METHOD FOR ESTIMATING IRRIGATION WATER USE IN SOUTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00808

SUBBASIN 13, POTOMAC RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-14, June 1979. 98 p, 18 Fig, 39 Tab, 6 Append.

Descriptors: *Industrial wastes, *Rivers, *Stream pollution, *Reservoirs, *Interstate rivers, *Water quality standards, *Irrigation requirements, Recreation, Water conservation, Conservation, Legal aspects, State jurisdiction, Wild rivers, *Pennsylvania, Potomac River basin.

Water use in Subbasin 13 in Pennsylvania is relatively light; the greatest increase in usage is expected to be for crop irrigation. Current usgage is 23.1 mgd and is projected to grow to only 49 mgd in 1990. Public water supply is the largest use in the basin, amounting to 7.8 mgd. There are 24 public water suppliers of which all but seven serve fewer than 1,000 customers. Most of the suppliers get their water from wells or springs. It is strongly recommended that applicable conservation measures be applied by all suppliers whose residential gpcd exceeds 50 or whose industrial usage appears excessive. The Potomac River Basin is besieged with interstate water issues because the metropolitan Washington, D.C. area is short of water and badly needs reservoir development upstream. One project, Sixes Bridge Reservoir on the Monocacy River in Maryland, would back water just across the Pennsylvania border into Adams County. Because of the projected irrigation demands in Pennsylvania, there is a potential conflict between Pennsylvania's right to the water flowing into the reservoir and the water supply interests downstream. Flooding in this basin is a minor problem. There are many opportunities for water-related outdoor recreation in Subbasin 13. In the future, additional picnic tables, swimming pools and flatwater for power boating will be needed. Three streams have been selected as candidates for the State's Scenic Rivers System. There are a few local groundwater quality problems from nutrient enrichment by agricultural runoff, improperly treated sewage, malfunctioning on-lot disposal systems and industrial waste discharges. (Garrison-Omniplan)
W84-00841

SUBBASIN 12, LOWER JUNIATA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-13, June 1979. 104 p, 19 Fig, 40 Tab, 6 Append.

Descriptors: *Flood frequency, *Irrigation requirements, *Sediment yield, *Soil erosion, *Surface water, *Rivers, Leachates, Conservation, Industrial wastes, Raw wastewater, Treatment facilities Silt, Water supply, *Pennsylvania, Upper Junita River.

About two-thirds of Subbasin 12 in Pennsylvania is forested, and one-quarter is farmland. This valley has become a center for the Amish sect, a religious group well known for their farming abilities. The urban centers in the basin are located primarily along the Juniata River. Flood damage is common occurrence in this basin because of the mountainous terrain surrounding the communities along the river. There are 20 damage centers and 22 damage reaches identified which have existing flood problems. There are 21 public water suppliers in the basin, of which 20 have their own sources of supply. The total water use in the basin in 1970 was 48 mgd, of which nearly 38 mgd was for self-supplied industry. If agricultural crop irrigation grows as projected, this may be one of the largest water uses in the future. Streamflows will be diminished if surface streams are used as the water source. There have been a few reported incidents of groundwater pollution from seepage of landfill leachates and malfunctioning septic systems. Erosion in the basin is a problem because of the extensive farming of agricultural land, which accounts for the slightly above-average sediment yield of 86 tons/sq. mile from the basin. It is recommended that agricultural conservation plans be implemented to reduce this problem. Inadequately treated industrial wastes, raw domestic wastewater and siltation are problems in Kishacoquillas Creek; however, the planned construction of Brown and Armagh Townships' treatment facilities should alleviate these wastewater problems. Subbasin 12 is ideally suited for many water-related outdoor recreational pursuits. (Garrison-Omniplan)
W84-00842

STATE WATER PLAN: SUBBASIN 6, LOWER CENTRAL SUSQUEHANNA RIVER.
Pennsylvania Dept. of Environmental Resources, Harrisburg. Office of Resources Management.
Report SWP-7, January 1980. 138 p, 20 Fig, 41 Tab, 6 Append.

Descriptors: *River basins, *Flood control, *Flood protection, *Electric power demand, *Dam construction, *Project planning, *Agriculture, *Long-term planning, Coliforms, Water quality standards, Recreation demand, Nonpoint pollution sources, *Pennsylvania, Lower Central Susquehanna River.

The Susquehanna River is a vital artery in the development of Subbasin 6, which lies entirely within the Valley and Ridge portion of Pennsylvania. This subbasin is described in one of 23 reports being published as a result of initial investigations and studies conducted in connection with the State Water Plan of the Commonwealth. The river supplies water for manufacturing and cooling of condensors for electric power generation, in addition to recreation opportunities. Very intense farming, which results in the area being the second leading crop producer in Pennsylvania, will mean increasing demands on the water resources for irrigation and will also increase nonpoint pollution to the streams. This area has also experienced intense flooding. To further reduce problems in the Middle Creek watershed, it is recommended that dams PA-636 and PA-638, floodway PA-639, and dike PA-640, be constructed as soon as possible. In the less populated areas, water quality is generally good except where polluted tributaries feed into it, such as at the mouths of Shamokin and Mahanoy Creeks. Also, there have been some algae blooms and high coliform concentrations in the Sunbury area. The report lists goals and objectives, and physical features and climate of the subbasin. (Garrison-Omniplan)
W84-00847

ER, WATTS, AND WILDS: HYDRO-
VER AND COMPETING USES IN NEW
LAND.
England River Basins Commission, Boston,

l Report of the New England River Basins
mission's Hydropower Expansion Study,
ust 1981. 136 p, 14 Fig, 25 Tab, 5 Append.

riptors: *Dams, *Hydroelectric power, *Elec-
power costs, *Hydroelectric plants, *Electric
er production, *Electrical equipment, Dam ef-
, Environmental effects, Regional planning,
tric power, Electric potential, Economic as-
, *New England, Northeast U.S.

BC has identified 320 existing or breached
sites in New England which could be retro-
l to generate hydroelectricity at an estimated
of 125 mills ($.125) per kilowatt hour or less.
e sites are the most economically attractive
screened from an inventory of over 10,000
throughout the six-state region. The total
rating capacity which could be developed at
320 sites ranges from 300 to 600 megawatts.
BC also identified 44 sites where no dams
ently exist and where power could be generat-
or an estimated cost of 115 mills per kilowatt
or less. The total generating capacity which
l be developed at these 44 sites ranges from
o 475 megawatts. Hydropower currently con-
tes between 4% to 6% of the electricity gen-
d annually in the region. If all of the 320
ing and breached dams that ranked most fa-
bly in the NERBC analysis were retrofitted
power plants, they could generate about 2
on megawatt hours, providing an additional
avings of 3.5 million barrels, or about 4.5% of
ent consumption. Some competing uses are
y to cause conflict, although not every impact
ydro development is necessarily negative.
ever, opposition to the construction of new
at previously undeveloped sites is likely to be
antial. (Garrison-Omniplan)
-00914

TER USE IN WISCONSIN, 1979,
logical Survey, Madison, WI. Water Re-
ces Div.
primary bibliographic entry see Field 7C.
-00928

TORIC AND PREHISTORIC PATTERNS
WATER USE IN THE CONNECTICUT
ER VALLEY: IMPLICATIONS FOR
TER RESOURCES PLANNING,
versity of Northern Iowa, Cedar Falls. Dept.
ciology, Anthropology and Social Work.
Cole, and M. T. Mulholland.
ilable from the National Technical Information
ice, Springfield, VA 22161 as PB84-140615,
e codes: A08 in paper copy, A01 in microfiche.
er Resources Center Publication No 143, Mas-
usetts Univ., Amherst, June 1983. 144 p, 13
12 Tab, 106 Ref, 2 Append. OWRT A-130-
SS, 14-34-0001-1123.

criptors: *Archaeology, *Climatic data, Clima-
gy, Data acquisition, *Forecasting, *Historic
ds, *Hydrologic data collections, Meteorologi-
data collection, *Planning, Climates, Drought,
d data, Flood forecasting, Forest Watersheds,
id climates, Prediction, Weather forecasting,
nnecticut River basin.

er supply forecasting typically is based upon
umented records from the recent past ranging
recent year-of-record data to 30-year 'nor-
', and, rarely (because of the lack of records),
year extremes. This report examines 144 years
nstrumented records at Amherst, Massachu-
, 400 years of proxy records from tree rings,
es, newspapers, and other historical records,
the records of thousands of years of archeaolo-
l data in order to evaluate the extent to which
ric and prehistoric climatic cycles might pro-
models for the future. The authors suggest
although long-term past data are poorly docu-
ted, historians should make more use of data
ch can be reasonably verified. The authors
d no clear statistical patterns or cyclicity in climatological records for the Amherst area. Neither do instrumented data support Nineteenth Century newspaper and diary accounts or archaeological reports. Nevertheless, climatologists, archaeologists, and historians seem to overrate climatological factors while, at the same time, downgrading historical data beyond the recent past and failing to employ tests of statistical significance. The humid Northeast would seem to have broader stress tolerances than assumed by some environmental activists, but greater limits than assumed by many developers and planning activists.
W84-00968

LEGAL ASPECTS OF STORED WATER IN FEDERAL RESERVOIRS IN KANSAS,
Kansas State Univ., Manhattan. School of Law.
For primary bibliographic entry see Field 6E.
W84-00971

OCCURRENCE AND USE OF GROUND WATER IN THE VENICE-ENGLEWOOD AREA, SARASOTA AND CHARLOTTE COUNTIES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. Sutcliffe, Jr., and T. H. Thompson.
USGS Open-File Report 82-700, 1983. 59 p, 21 Fig, 8 Tab, 14 Ref.

Descriptors: *Groundwater availability, *Groundwater quality, Aquifers, Water use, *Florida, Floridan aquifer.

In a 75-square-mile area of coastal Sarasota and Charlotte Counties, demand for water is increasing. Groundwater, the principal source of supply, is distributed largely by public water systems. Principal water-bearing formations in descending order, include the surficial aquifer, artesian zone 1 in the Tamiami Formation, zone 2 in the upper part of the Hawthorn Formation, zone 3 in the lower part of the Hawthorn Formation and upper part of the Tampa Limestone, and zones 4 and 5 which comprise the Floridan aquifer. The surficial aquifer, except near tidewater, provides limited supplies of freshwater to wells. Artesian zone 1 is the major aquifer for public supply. It is contaminated by saline water in some areas, either as a result of inundation by storm-driven tides or by upwar leakage of mineralized water from underlying aquifers through uncased or improperly constructed wells. The city of Venice obtains some water from zone 2, but the water is brackish in much of the area. The water is suitable for irrigation in parts of the area. Except for local use of water for watering livestock and maintaining ponds, the water from zones 3, 4, and 5 is little used because of its poor quality. (USGS)
W84-00987

PUMPAGE OF WATER IN LOUISIANA, 1980,
Geological Survey, Baton Rouge, LA. Water Resources Div.
W. H. Walter.
Louisiana Department of Transportation and Development, Baton Rouge, Water Resources Special Report No 3, 1982. 15 p, 3 Fig, 3 Tab, 25 Ref.

Descriptors: *Water utilization, *Louisiana, Withdrawal, Groundwater, Surface waters, Saline water, Consumptive use, Aquifers, Water supply, *Water use, *Pumpage, *Water-use trends, Domestic use, Public-supply use, Rural use, Irrigation use, Industrial use, Thermoelectric use, Livestock use, Per-capita use.

In 1980 an estimated 12,500 million gallons per day of water was pumped for various uses in Louisiana; 10,700 million gallons per day was pumped from surface-water sources and 1,780 from ground water. Two-thirds of the surface-water withdrawals were from the Mississippi River, mainly for industrial use; and about 56% of the ground water was pumped from the Chicot aquifer in southwestern Louisiana, mainly for irrigation. Total withdrawal use of water in the State increase by 6%, 1975-80. Use of surface water increased by 5% while use of ground water increased by 14%. (USGS)
W84-00997

6E. Water Law and Institutions

HARBOR MANAGEMENT STRATEGIES FOR NEW ENGLAND,
New England River Basins Commission, Boston, MA.
For primary bibliographic entry see Field 6B.
W84-00907

INDUSTRIAL WASTEWATER,
Texas Univ. at Austin. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5G.
W84-00917

INTERSTATE WATER LAW ISSUES: UNILATERAL STATE LEGISLATION, ORIGINAL SUITS IN THE SUPREME COURT, INTERSTATE COMPACTS,
North Carolina Univ. at Chapel Hill. Inst. of Government.
M. S. Heath, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140532, Price codes: A04 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Completion Report, September, 1983. 48 p, 85 End notes. OWRT A-121-NC(b)(2), 14-34-0001-2135.

Descriptors: *Water law, *Interstate compacts, *Legal aspects, Legislation, *Judicial decisions, Water importing, State jurisdiction, Proprietary power, Constitutional law, Groundwater, Surface water, Equitable apportionment, Riparian rights.

The principal legal avenues for resolving interstate water disputes involve either legislation, litigation or interstate cooperation. This report addresses one option in each of these categories that may be available to state governments: unilateral state legislation designed to restrict outsiders from access to a state's water resources; original actions against a neighboring state in the U.S. Supreme Court; and interstate compacts. The opportunities for unilateral state legislation have been severely restricted by recent Supreme Court decisions, though several developing areas of constitutional law should be monitored closely for their possible future impact on this subject. Original actions in the Supreme Court may offer the possibility that the court will place some limitations on withdrawal of interstate waters by a state, and this possibility may provide some leverage for another state that wants to contest this withdrawal, but original actions are beset by a number of obstacles and uncertainties. The interstate compact has long been regarded as a preferred enforceable alternative for resolving a water resources dispute - if you can get it.
W84-00960

PROBLEMS AND ISSUES RELATED TO MANAGING WATER SUPPLY AND WATER QUALITY BETWEEN NORTH CAROLINA AND VIRGINIA,
North Carolina State Univ. at Raleigh. Dept. of Political Science and Public Administration.
T. D. Edgmon, and R. Tarver.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140540, Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute Completion Report, September, 1983. 48 p, 49 End notes. OWRT A-121-NC(a)(1), 14-34-0001-2135.

Descriptors: *Institutional constraints, *Legal aspects, *Political aspects, *Water supply, Water quality, *Interstate commissions, Water supply development, *Water quality management, Political constraints, Policy making, Legislation, Water laws, Administrative decisions, State jurisdiction, Water allocation, Interbasin transfers, Riparian rights, Interstate compacts, Eutrophication, Surface water, Groundwater.

The purpose of this report was to outline the problems, alternative solutions, and institutional arrangements associated with interstate issues of

managing water supply and water quality between North Carolina and Virginia. In this process, a political analysis was conducted, which indicated that because of inequalities in the distribution of costs and benefits associated with water resource use between parties on different sides of the state line, officials of the respective states do not share a common set of interests or political agenda. This conflict of interest could lead to either a benign neglect of water resource problems of the area, court actions, or the development of an institutional framework for the settlement of differences between interested parties and the management of water resources on an interstate, regional basis. The greatest impediment to the evolution of an interstate institution is the lack of state legislation upon which such an entity could be based. Given the legal status quo, the only positive steps that can be taken in the short run in the absence of legislation are executive and administrative actions, which over the long run, may be unstable and subject to change.
W84-00961

LEGAL ASPECTS OF STORED WATER IN FEDERAL RESERVOIRS IN KANSAS,
Kansas State Univ., Manhattan. School of Law.
J. C. Peck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-140649, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Contribution No 241, August 1983. 85 p, 6 Fig. OWRT A-105-KAN(1), 14-34-0001-2118.

Descriptors: *Water rights, *Storage right, *Reservoir right, *Reservoir storage right, *Drought, *Federal nonreserved rights, Appropriation, Storage, Reservation right, Safe yield, Low-flow frequency curve, Condemnation, Federal reserved rights, Water quality.

Water is stored to protect against natural fluctuations. Kansas statutes are unclear relative to existence of such rights other than that obtainable by the Kansas Water Office. But the Division of Water Resources (DWR) has long recognized storage rights. Detailed procedures exist for obtaining the water reservation right from the Chief Engineer of the DWR by the Kansas Water Office. Federal law requires state assurance for payment for space used for municipal and industrial water storage. The reservation right has some similarities with an appropriation right, including a listing of priority dates and specification of quantity limitation. Once obtained, the reservation right is subject only to federal government condemnation. Concern has risen about protecting water quality releases made by the Corps of Engineers. This concern remains unsolved. Several possible solutions, including one in the Water Plan Storage Act, do exist, however. The Federal Government has a water right for storage designated for various authorized purpose. But the law is unclear, particularly in Corps of Engineers reservoirs, as to the exact nature of such right. It could arguably be a federal reserved right or another species of rights denominated as a federal non reserved right.
W84-00971

6G. Ecologic Impact Of Water Development

PROCEDURES FOR ASSESSMENT OF CUMULATIVE IMPACTS OF COAL MINING ON THE HYDROLOGIC BALANCE,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-00780

APPRAISAL OF THE INTERCONNECTION BETWEEN THE ST. JOHNS RIVER AND THE SURFICIAL AQUIFER, EAST CENTRAL DUVAL COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Spechler, and R. B. Stone, Jr.
USGS Water-Resources Investigations Report 82-4109, 1983. 34 p, 14 Fig, 3 Tab, 33 Ref.

Descriptors: *Surface-groundwater relationship, *Saline water intrusion, Hydrogeology, Aquifers, Water quality, Channel improvements, St. John River, *Surficial aquifer, Limestone unit, *Florida, Duval County.

The proposed deepening of the navigation channel in the St. Johns River to about 46-48 feet below sea level (45 feet below mean low water) may breach up to 11 feet of limestone unit of the lower part of the surficial aquifer along a 25-mile channel. The limestone supplies water to numerous domestic wells along the river in the Jacksonville area. Recent channel improvements to about 39 feet below sea level have already breached the limestone at many locations. Where breaching has not yet occurred, less than 1 to 6 feet of undifferentiated sediments overlie the limestone. These sediments, consisting predominantly of sand, are generally too permeable to form an effective confining layer. Chloride concentrations determined from water in wells tapping the limestone unit range from 8 to 6,600 milligrams per liter. However, chloride concentrations in water from wells located more than 500 feet from the river, were generally less than 30 milligrams per liter. The proposed dredging operation is not expected to alter significantly the present hydrologic system. The current position of the interface most likely represents conditions that will be present after future channel improvements. (USGS)
W84-00975

RESERVOIR-DEVELOPMENT IMPACTS ON SURFACE-WATER QUANTITY AND QUALITY IN THE YAMPA RIVER BASIN, COLORADO AND WYOMING,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-01042

7. RESOURCES DATA

7A. Network Design

EVALUATION OF THE STREAM-FLOW DATA IN PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
H. N. Flippo, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-202002, Price codes: A04 in paper copy, A01 in microfiche. USGS Water Resources Investigations 82-21, December 1982. 56 p, 7 Fig, 8 Tab, 14 Ref.

Descriptors: *Network analysis, *Data collection, *Pennsylvania, Network design, Regional analysis, Gaging stations, Hydrologic data.

The potential for improvement of currently adopted data-transfer mechanisms, which consist of a series of regression equations that relate low-, mean-, and flood-flow characterististics, is evaluated by the technique known as Network Analysis for Regional Information (NARI). This evaluation showed that little improvement in the data-transfer mechanisms can be expected as a result of continued operation of various combinations of gages for as long as 25 years. Therefore, it is proposed that all current gages that are neither managerial nor design specific in purpose (are proposed to be) be discontinued when records adequate for definition of flow characteristics at the gaging site have been collected. Types of data collected, their most commonly used summarizations, and known usage of site-specific data are tabulated. This report cites 14 references. (USGS)
W84-00809

QUALITY ASSURANCE PRACTICES FOR THE CHEMICAL AND PHYSICAL ANALYSES OF WATER AND FLUVIAL SEDIMENTS,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 5A.
W84-00812

PROCEEDINGS: ILLINOIS WATER-USERS MEETING, PEORIA, ILLINOIS, RUARY 23-24, 1982.
Geological Survey, Urbana, IL. Water Res Div.
Available from the USGS, OFSS, Lakewoo 80225, Price: $12.00 in paper copy, $3.50 in fiche. USGS Open-File Report 82-1001, D ber, 1982. 90 p, 10 Fig, L. G. Toler, co

Descriptors: *Water measurement, *Water agement, Hydrologic data collection, *I Water agencies, Data acquisition, Data users.

The increased demand for water and conce the quality of water resources of Illinois ha to increased demand for water-resources Representatives of the major water-data coll and water-data using agencies met in Peori nois, on February 23-24, 1982, to (1) exc information on current water-data program needs; (2) identify areas where data are ne and (3) foster coordination and cooperation a agencies. Recommendations of the group inc (1) annual meetings of agencies for coordinati activities; (2) standard methods for collectin analyzing water data be adopted; (3) a centr data system be established as a means of sh water data; (4) water data should be indexe cataloged, either by each agency or by some tralized system; (5) a statewide water data co nation committee should be formed with me from all water-related agencies; (6) a work be formed to consider the use of uniform w data collection agencies in the State to coord and maximize efforts on basin intensive study ects. (USGS)
W84-00818

WATER-RESOURCES INVESTIGATIONS THE U.S. GEOLOGICAL SURVEY IN SO DAKOTA,
Geological Survey, Huron, SD. Water Reso Div.
E. F. LeRoux, and E. M. Decker.
Available from the OFSS, USGS, Lakewood 80225, Price: $6.50 in paper copy, $3.50 in m fiche. USGS Open-File Report 82-912, July 47 p, 3 Tab.

Descriptors: *Hydrologic data, Water resou *South Dakota.

Project descriptions and lists of hydrologic stations are presented to show the status of U.S. Geological Survey water-resources studi South Dakota. (USGS)
W84-00827

LONG RANGE PLANS FOR HYDROLO INVESTIGATIONS,
Geological Survey, Albuquerque, NM. Water sources Div.
For primary bibliographic entry see Field 6B.
W84-00852

AN EVALUATION OF IDAHO STREA GAGING NETWORKS,
Geological Survey, Boise, ID. Water Resou Div.
E. W. Quillan, and W. A. Harenberg.
Available from the OFSS, USGS, Lakewood, 80225, Price $7.75 in paper copy, $3.50 in mi fiche. USGS Open-File Report 82-865, Octo 1982. 57 p, 74 Fig, 9 Tab, 14 Ref.

Descriptors: Surface water, *Gaging stati *Network design, Cost analysis, *Idaho, Field routes.

Network Analysis for Regional Informat (NARI) and the Cost-Effectiveness Proced were tested by applying them to stream-gag networks in Idaho. NARI was used to determ network design strategies that would maximize value of additional data. Value of data was me ured as the decrease in the probable true standa error of regional regression equations. NARI in cated that no significant decrease in regressi error can be achieved by the collection of additi

a and that better models should be sought. ajor modifications to NARI are necessary to t widely applicable. The Cost-Effectiveness dure was used to determine optimal network ion strategies. It showed network uncertain- be reduced when six- or one-visit per year um constraints are in force. Sensitivity to s cost factors was examined. Attempts to networks that included sites for collection undwater and water-quality data were un- sful. (USGS)
0866

Data Acquisition

LLATION AND SERVICE MANUAL U.S. GEOLOGICAL SURVEY MANO- RS,
gical Survey, Reston, VA.
Craig.
ble from the Eastern Distribution Br. 604 S. Pickett St. Alexandria, VA 22304. Techniques of Water-Resources Investiga- Book 8, Instrumentation, Chapter 2A, 1983. 5 Fig.

ptors: *Bubble gages, *Manometers, Water- gages, STACOM Manometer, Screw-type neter, *Instrumentation.

nanual describes the installation, operation, aintainance of the bubble-gage manometers tly used by the U.S. Geological Survey. applications of these devices, such as the nanometer and differential manometer, are ed, and accessories available for them are ed. The bubble gage (water-stage mano- with gas-purge system) described in the In- on and Service Manual, October 1962, has xtensively modified and developed into the OM device. This chapter is the manual for ACOM unit and an update of the manual for ew-type bubble gage. A parts list is included h units. (USGS)
0811

AULIC CONSIDERATIONS IN SAM- THE UNSATURATED ZONE WITH IN- D GRAVITY LYSIMETERS,
gical Survey, Albany, NY. Water Resources

rimary bibliographic entry see Field 2G.
1018

UREMENT AND COMPUTATION OF MFLOW: VOLUME 1. MEASUREMENT AGE AND DISCHARGE,
gical Survey, Menlo Park, CA. Water Re- Div.
antz.
ble from Supt. of Documents, GPO, Wash- DC 20402, Price, $13.00 per set. USGS Supply Paper 2175, 1982. 284 p, 138 Fig, 15 Ref.

ptors: *Discharge(Water), *Discharge meas- nt, *Stage discharge relations, *Water levels, ater, Current meters, Ice cover, Open-chan- v, Peak discharge, Pipe flow, Stream gages, streams, Water level recorders, *Stream- ontrols, Acoustic-velocity meters, Deflec- neters, Discharge-rating shifts, Sand chan- ope.

ream-gaging manual, in two volumes, de- the equipment and technical work involved ining systematic records of streamflow. The is treated in accordance with six major Volume 1, titled 'Fieldwork', covers (1) n of gaging-station sites, (2) measurement e, and (3) measurement of discharge. In to make the text as broadly as possible, ions of instrumentation and measurement ned at the technician, and discussions of entation of computational procedure are at the junior engineer who has background c hydraulics. The section on the design of station networks is written for the experienced hydrologist who plans such networks. (USGS)
W84-01048

7C. Evaluation, Processing and Publication

FLOOD OF JUNE 13-15, 1981, IN THE BLANCHARD RIVER BASIN, NORTHWESTERN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
E. E. Webber.
USGS Water-Resources Investigations 82-4044, 1982. 32 p, 16 Fig, 5 Tab, 4 Ref.

Descriptors: *Flood data, *Flood profiles, Floods, Flood recurrence interval, Rainstorms, Blanchard River Basin, *Ohio.

The flood of June 13-15, 1981, in the Blachard River Basin in Northwestern Ohio caused major damage in Findlay, Ottawa, and adjacent rural areas. Approximately 25% of Findlay and 55% of Ottawa were flooded. Estimated crop damage was $12 million in Hancock County, $7 million in Wyandot County, and $3 million in Putnam County. During the 1981 flood, the maximum gage height of the Blanchard River at Findlay was 17.43 feet, gage datum. This was 0.67 foot higher than the previous peak of record of 16.76 feet that occurred February 11, 1959. The corresponding peak discharge, 13,000 cubic feet per second, was estimated to have a recurrence interval of 50 years. Recurrence intervals of peak flows at other locations on the Blanchard River and on tributary streams were estimated to range from 25 to more than 100 years. Records of precipitation, peak and daily stream discharges, and minimum stream level profiles are given. (USGS)
W84-00777

GEOLOGY AND GROUND WATER RESOURCES OF SUSSEX COUNTY AND THE WARREN COUNTY PORTION OF THE TOCKS ISLAND IMPACT AREA,
New Jersey Bureau of Geology and Topography, Trenton.
For primary bibliographic entry see Field 2F.
W84-00783

WATER RESOURCES RESUME: STATE ATLAS SHEET NO. 23, PARTS OF BERGEN, MORRIS AND PASSAIC COUNTIES,
New Jersey Bureau of Geology and Topography, Trenton.
K. Widmer, H. Kasabach, and P. Nordstrom.
New Jersey Geological Survey, Geologic Report Series No 10, 1966. 34 p, 4 Fig, 2 Append.

Descriptors: *Geologic formations, *Water supply, *Wells, *Groundwater availability, Physiographic provinces, Catchment areas, Watersheds, Topography, Surface water, Drilling, *Atlas, *New Jersey, Bergen County, Morris County, Passaic County.

The text, when used with an accompanying overlay and State Topographic Atlas Sheet, will provide a convenient source of information as to the availability of groundwater, major surface water supplies, topography, and other essential factors which affect the water resources in the various counties and municipalities of the northeastern part of New Jersey. The report has been compiled from records available in the Bureau of Geology. It includes a list of 280 wells. Public water supply wells giving more than 100,000 gallons per day, as well as all private wells of similar capacity whose records are on file with the Department of Conservation and Economic Development, have been plotted on the overlay. Within the Atlas Sheet 23 area, there are over 275 wells. The majority of these wells, at the time they were drilled, had a capability in excess of 300,000 gallons per day. Five geologic formations in the study area must be considered when drilling a well. Four are shown on the overlay map, while the fifth, the Pleistocene deposits, must be considered separately as a potential source of water in restricted areas. Successful wells in any of the geologic formations are completed within 400 feet of the surface. Nearly all of the area east of Saddle River is within the franchise area of the Hackensack Water Company. The surface water resources of the Hackensack Basin are completely developed. (Fazio-Omniplan)
W84-00792

STATISTICAL SUMMARIES OF NEW JERSEY STREAMFLOW RECORDS,
S. L. Laskowski.
Water Resources Circular 23, New Jersey Dept. of Environmental Protection, Trenton, 1970. 264 p, 3 Fig, 21 Ref, 1 Append.

Descriptors: *Daily hydrographs, *Data acquisition, *Hydrologic data collections, *Statistical analysis, *Stream discharge, *Stream gages, *On-site data collection, Gages, Flow, Statistical methods, Statistics, Parametric hydrology, Data collections, *New Jersey.

The records for 79 of approximately 100 stream-gaging stations presently or previously operated in New Jersey, plus records for three stations in Pennsylvania, and one in New York are presented in summarized form. In addition to including a greater number of stations in this report, more years of record and more tables are listed for each station than in the 1958 report. A description of the station, three arrangements of data summarizing the daily flow records, and one table listing statistics of the monthly mean flows are provided. No data representing instantaneous extreme flows are given. Plotting positions for the three types of curves describing the characteristics of daily discharge are listed for each station. Statistical parameters are also presented so that alternate curves may be drawn. All stations included in this report have five or more years of record. The data presented are based on observed flow past the gaging station. Since any streamflow record is a sample in time, the data derived from these records can provide only a guide to expected future flows. For this reason the flow records are analyzed by statistical techniques, and the magnitude of sampling errors should be recognized. These analyzed data will be useful to a large number of municipal, state, and federal agencies; industries; utilities; engineers; and hydrologists concerned with the availability, conservation, control, and use of surface waters. The tabulated data and curves can be used to select sites for water supplies and to determine flood or drought storage requirements. The statistical values presented herein can be used in computer programs. (Garrison-Omniplan)
W84-00800

SEMIANNUAL WATER-LEVEL AND POTENTIOMETRIC CONTOURS OF TWO WATER-YIELDING ZONES IN THE SURFICIAL AQUIFER, 1975-79, NAPLES, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. C. Buchmiller.
USGS Open-File Report 82-120, 1982. 2 Maps, 25 Fig, 2 Tab, 6 Ref.

Descriptors: *Aquifers, *Potentiometric levels, *Water level fluctuations, Water supply, Water table, *Maps, *Florida, Collier County, Naples.

Potable ground water in the Naples area along the coastal ridge of western Collier County, Florida, is available from two principal sources--the water-table zone and the pumped zone, both within the surficial aquifer. The primary source of public supply is from the pumped zone, locally known as the Coastal Ridge aquifer. Water levels in wells in the pumped zone respond rapidly to pumpage and usually indicate a cone of depression in most of the highly urbanized Naples area. The cone of depression caused by pumpage has created significant water-level differences between the water-table zone and pumped zone. Water-level differences in the two zones from 1975 to 1979 frequently exceed 10 feet. The maps have been drawn to be representative of hydrologic conditions in both zones for the wet and dry seasons from 1975-79. (USGS)
W84-00803

SATURATED THICKNESS OF THE HIGH PLAINS REGIONAL AQUIFER IN 1980, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
USGS Water Resources Investigations Open-File Report 82-760, September 1982. 2 Sheets, 7 Ref.

Descriptors: *Groundwater, *Aquifers, Saturation, Bedrock, *Oklahoma, *High Plains Regional Aquifer System, *Maps.

The High Plains aquifer in Oklahoma is part of regional aquifer system extending from South Dakota southward to Texas and New Mexico. The principal aquifer, the Ogallala Formation of Tertiary age, is hydraulically connected with other unconsolidated deposits, principally of Quaternary age. During 1978, the U.S. Geological Survey began a 5-year study of the High Plains regional aquifer system to provide hydrologic information for evaluation of the aquifer and to develop and evaluate predictive computer models of it. This report consists of two maps showing the 1980 saturated thickness of the High Plains regional aquifer in northwestern Oklahoma. The saturated thickness was derived from published reports showing the aquifer base and the 1980 water table; the difference in altitude between these two surfaces gives the saturated thickness of the aquifer. (USGS)
W84-00804

CHEMICAL QUALITY OF WATER IN THE UPPER PART OF THE FLORIDIAN AQUIFER, DUVAL COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. Thompson.
USGS Water Resources Investigation Open-File Report 82-119, 1982. 1 Map, 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Groundwater, *Water quality, *Florida, Chlorides, Dissolved solids, Hardness(Water), Atlantic Coastal Plain, Floridian Aquifer, Chemical water types, Duval County, Water chemistry, *Maps.

Between 1977 and 1980, water samples from 211 wells that penetrate as much as 900 feet of the upper part of the Floridian aquifer were analyzed for major inorganic ions. Maps show the areal distribution of dissolved solids, total and noncarbonate hardness, chloride, and chemical water types. Variation in water quality with aquifer depth was not considered. In general, the concentrations of the constituents were lowest in the southwest area of the county, and highest in the southeast. Ranges of concentrations (in milligrams per liter) were: dissolved solids, less than 200 to as much as 623; total hardness as calcium carbonate, less than 200 to as much as 430; and chloride, less than 10 to as much as 210. Noncarbonate hardness ranged from less than 30 to as much as 70% of the total hardness. Six chemical types were defined, based upon the predominant cations and anions. The most prominent type was a calcium sulfate mass extending into central Duval County from the southeast. Calcium bicarbonate and calcium-magnesium bicarbonate types were found in most of the rest of the county. (USGS)
W84-00806

MAP SHOWING GROUNDWATER CONDITIONS IN THE TONTO BASIN AREA, GILA COUNTY, ARIZONA--1979,
Geological Survey, Phoenix, AZ. Water Resources Div.
E. E. Denis.
USGS Water-Resources Investigations/Open-File Report 82-116, December 1981. 1 Map, 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Groundwater, *Water levels, *Water quality, Water wells, *Maps, *Arizona, Gila County, Tonto basin area.

The Tonto basin area includes about 955 square miles in central Arizona. The rocks in the Tonto basin area are divided into four water-bearing units: alluvium, basin fill, consolidated sedimentary rocks, and igneous and metamorphic rocks. The water-bearing characteristics of the rocks may vary greatly within the boundaries of a unit and between units because of complex faulting or fracturing, and because of the relative topographic positions of the units. Information shown on the map includes altitude of the water level, depth to water, well depth, spring discharge, specific conductance, and fluoride concentration. Scale 1:125,000. (USGS)
W84-00807

THE BENCHMARK FARM PROGRAM-- A METHOD FOR ESTIMATING IRRIGATION WATER USE IN SOUTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. D. Duerr, and J. T. Trommer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224197, Price codes: A04 in paper copy, A01 in microfiche. USGS Water Resources Investigations 82-17, 1982. 49 p, 14 Fig, 4 Tab, 10 Ref.

Descriptors: *Irrigation water, *Water use, Crops, Irrigation systems, Southwest Florida Water Management District, *Florida.

Irrigation water-use data are summarized in this report for 74 farms in the Southwest Florida Water Management District. Most data are for 1978-90, but 18 farms have data extending back to the early 1970's. Data include site number and location, season and year, crop type, irrigation system, monitoring method, and inches of water applied per acre. Crop types include citrus, cucumbers, pasture, peanuts, sod, strawberries, and tropical fish farms are also included. Water-application rates per growing season ranged from 0 inches per acre for several citrus and pasture sites to 239.7 inches per acre for a nursery site. The report also includes rainfall data for 12 stations throughout the study area. (USGS)
W84-00808

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from the OFSS, USGS Lakewood, CO 80225, Price: $3.50 in paper copy, $1.00 in microfiche. USGS Open-File Report 82-915, 1982. 1 Sheet, 1 Fig.

Descriptors: *Potentiometric level, Groundwater, Hydrologic aspects, Aquifer, Hydrogeology, *Florida, St. Johns River Water Management District, *Maps.

This map presents the potentiometric surface of the Floridan aquifer in the St. Johns River Water Management District and vicinity for May 1982. The Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area 20-foot intervals are used to show a deep cone of depression. The potentiometric surface ranged from 128 feet above NGVD (National Geodetic Vertical Datum of 1929) in Polk County to 68 feet below NGVD in Nassau County. Because of above average rainfall, water levels began to recover from record low levels set in September 1981 in many counties. Except in a few places, water levels throughout the District rose above May 1981 levels. May 1982 levels were as much as 9 feet and commonly 1 to 3 feet higher than the below normal May 1981 levels. (USGS)
W84-00819

MAP OF THE ANTELOPE VALLEY-EAST KERN WATER AGENCY AREA, CALIFORNIA, SHOWING GROUND-WATER SUBUNITS AND AREAS, AND WELL HYDROGRAPHS, 1962 TO 1982,
Geological Survey, Menlo Park, CA. ...sources Div.
F. M. Glenn.
USGS Open-File Report 821-917, 1982. ... Ref.

Descriptors: *Water-level hydrographs, ...water, Antelope Valley-East Kern Area, ...nia, *Maps.

A map (scale 1:62,500) shows ground-w... its and areas, and well hydrographs f... 1982, in the Antelope Valley-East K... Agency area, California. (USGS)
W84-00820

PERCENTAGE CHANGE IN SAT... THICKNESS OF THE HIGH ... AQUIFER, WEST-CENTRAL KANSAS ... AVERAGE 1980-82,
Geological Survey, Lawrence, KS. ... sources Div.
M. E. Pabst.
Available from OFSS, USGS, Fed. ... wood, CO 80225, Price: $4.50 in paper c... in microfiche. USGS Open-File Repor... 1982. 1 sheet, 1 Fig, 9 Ref.

Descriptors: *Approximation method, *... ic data, *High Plains Aquifer, ... distribution(applied), Water managemen... *Kriging, *Kansas, Colorado, *Maps.

A statistical technique, called kriging, ... grammed for a computer to interpolate h... data based on a network of 296 measured ... west-central Kansas and eastern Colo... computer program generated estimated ... selected hydrologic data at the center ... mile section in the Western Kansas Gro... Management District No. 1. This program ... ed contouring of the data that are needed ... the management of ground water for ... The kriging technique produced a map ... trates the percentage change in saturated ... of the High Plains aquifer from 1950 to ... 1980-82 in west-central Kansas. Estimate... in saturated thickness of the aquifer, as ... the map, range from about a 50% incr... 100% decrease. (USGS)
W84-00821

DRAINAGE DIVIDES, MASSACHU... NASHUA AND CONCORD RIVER BAS...
R. A. Brackley, and S. W. Wandle, Jr.
USGS Open-File Report 82-924, 1982. ... Maps.

Descriptors: *Drainage basins, Surface ... *Massachusetts, Sites, *Hydrologic data, ... Nashua River, Sudbury River, Assabe... Concord River, Merrimack River, M... Western Essex, Eastern Worcester counti...

Drainage boundaries for selected subbasi... Nashua and Concord River basins in M... western Essex, and eastern Worcester ... Massachusetts, are delineated on 22 top... quadrangle maps at a scale of 1:24,000. ... basins are shown for all U.S. Geologica... data-collection sites and for mouths ... rivers. Drainage basins are shown for the ... lakes or ponds and for streams where the ... area is greater than 3 square miles. Succes... along watercourses are indicated where ... vening area is at least 6 square miles on ... streams or 10 square miles along the ... River, Concord River, Merrimack River ... River, or Sudbury River. (USGS)
W84-00822

ANNUAL SUMMARY OF GROUND... CONDITIONS IN ARIZONA, SPRING ... SPRING 1982,
Geological Survey, Tucson, AZ. Water R... Div.
USGS Open-File Report 82-1009, Februa... 2 Sheets, 5 Fig, 2 Tab, 19 Ref.

Descriptors: Water levels, *Water-leve... ations, *Pumpage, Irrigation, *Arizona, E...

ıge lowlands province, Central highlands prov-
e, Plateau uplands province, *Withdrawal,
aps, *Groundwater.

e withdrawal of ground water was about 5.4
ion acre-feet in Arizona in 1981, which is about
,000 acre-feet more than the amount withdrawn
980. Most of the increase in 1981 was in the
unt of ground water used for irrigation in the
in and Range lowlands province. Through
l, slightly more than 189 million acre-feet of
nd water had been withdrawn from the
nd-water reservoirs in Arizona. The report
ains two small-scale maps that show ground-
er pumpage by areas and the status of the
nd-water inventory in the State. The main
, which is at a scale of 1:500,000, shows poten-
well production, depth to water in selected
s in spring 1982, and change in water level in
ted wells from 1977 to 1982. A brief text
marizes the current ground-water conditions in
State. (USGS)
-00824

ECTED HYDROLOGIC DATA, 1978-80,
CE RIVER BASIN, UTAH,
logical Survey, Salt Lake City, UT. Water
urces Div.
I. Waddell, J. E. Dodge, D. W. Darby, and S.
Theobald.
S Open File Report 82-916, 1982. 73 p, 13
22 Tab, 3 Ref.

riptors: Water resources, Utah, Hydrologic
Climatic data, Groundwater, Price River
, *Utah.

report presents data collected in the coal
of the Wasatch Plateau and Book Cliffs in
Price River basin, east-central Utah. Ground-
urface-water and climatologic data that were
cted during October 1978 to September 1980
ncluded in the report. Ground-water data in-
water levels in wells, discharges to springs
hemical analyses of water from wells, springs,
mines. Surface-water data include meas-
ents of daily stream discharges at selected
and analyses of the chemical, physical, and
gical characteristics of water in streams and in
eld Reservoir. Climatologic data include
ds of daily precipitation and solar radiation.
included in the report are mineralogic and
le-size analyses of streambed samples, analy-
benthic invertebrates at selected stream sites,
nalyses of suspended stream runoff in Soldier
. (USGS)
00825

CTS OF URBANIZATION ON THE MAG-
DE AND FREQUENCY OF FLOODS ON
LL STREAMS IN TENNESSEE-BASIC
REPORT NO. 2,
gical Survey, Nashville, TN. Water Re-
es Div.
rimary bibliographic entry see Field 4C.
00826

-VARIOGRAM ESTIMATION AND UNI-
AL KRIGING PROGRAM (COMPUTER
RAM DOCUMENTATION, USER'S
UAL),
gical Survey, Tacoma, WA. Water Re-
s Div.
krivan, and M. R. Karlinger.
Computer Contribution Report, 1979. 122
Ref.

ptors: *Statistical estimating analysis, *Re-
analysis, *Networks, *Kriging, Universal
, *Variogram, Semi-variogram, Geostatis-
nterpolation, Stochastic interpolation, Block
, Drift estimation, Autocorrelation, Infor-
value.

m K603 contains procedures necessary for
ochastic-interpolation algorithm known as
sal kriging, as originally described by G.
ron. By specifying a theoretical semi-vario-
nd functional terms of an assumed underly-
nd, or drift, kriging provides unbiased esti-
mates of values of variables in neighborhoods of autocorrelation. Given single observations and their spatial or temporal distribution the technique yields point estimate variances at arbitrary locations. In the absence of measurement errors, which can be incorporated in the analysis, kriging is an exact interpolator. The program includes four procedures used in kriging: (1) semi-variogram estimation; (2) universal kriging for optimization of the drift-variogram set; (3) universal kriging for arbitrary point or block estimation; and (4) universal kriging for drift-coefficient estimation. In addition, an option to apply kriging in block-estimation problems is also included. (USGS)
W84-00829

GROUND-WATER DATA FROM SELECTED WELLS IN ALLUVIAL AQUIFERS, POWDER RIVER BASIN, NORTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. K. Well.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $16.00 in paper copy, $4.00 in microfiche. USGS Open-File Report 82-856, 1982. 39 p, 1 Fig, 31 Tab, 4 Ref.

Descriptors: *Chemical analyses, Drillers logs, *Groundwater data, *Water quality, Powder River basin, *Wyoming, Alluvial aquifers, Well records.

Data on selected wells completed in alluvial aquifers in the Powder River structural basin in northeastern Wyoming are presented without interpretation. Records of 300 wells, chemical analyses of water from 43 wells, and logs of 113 wells are listed in three tables. A map showing location of wells is included. (USGS)
W84-00830

HYDROGRAPHS OF WATER LEVELS IN OBSERVATION WELLS IN IDAHO, 1971-82,
Geological Survey, Boise, ID. Water Resources Div.
H. W. Young.
USGS Open-File Report 83-225, 1983. 282 p, 8 Fig, 1 Ref.

Descriptors: *Water-level fluctuations, *Groundwater, *Water levels, *Groundwater depletion, *Idaho.

For the period 1971-82, this report presents hydrographs of water levels in observation wells in the Statewide monitoring network operated by the U.S. Geological Survey in cooperation with the Idaho Department of Water Reources. The data are conveniently made available to supplement an interpretive report that describes Statewide water-level trends and their causes, which will be published separately.
W84-00831

DRAINAGE DIVIDES, MASSACHUSETTS--IPSWICH AND LOWER MERRIMACK RIVER BASINS AND NORTHEAST COASTAL BASINS,
Geological Survey, Boston, MA. Water Resources Div.
R. A. Brackley, and S. W. Wandle, Jr.
USGS Open-File Report 83-209, 1983. 2 p, 28 Maps.

Descriptors: *Ipswich River, Parker River, Mystic River, Shawsheen River, *Merrimack River, Neponset River, Charles River, Essex, Eastern Middlesex, Eastern Norfolk, Northern Plymouth, and Suffolk counties, *Massachusetts.

Drainage boundaries for selected subbasins of the Ipswich and lower Merrimack River Basins and Northeast Coastal Basins in Essex, Eastern Middlesex, Eastern Norfolk, Northern Plymouth, Suffolk Counties, Massachusetts, are delineated on 28 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 square miles on tributary streams or 10 square miles along the Charles River, Ipswich River, Merrimack River, Mystic River, Neponset River, Parker River, or Shawsheen River. (USGS)
W84-00833

COMPILATION OF GROUND-WATER QUALITY DATA FOR SELECTED WELLS IN ELMORE, OWYHEE, ADA, AND CANYON COUNTIES, IDAHO, 1945 THROUGH 1982,
Geological Survey, Boise, ID. Water Resources Div.
D. J. Parliman.
Available from the OFSS, USGS, Box 25, Denver, CO 80225, Price: $20.25 in paper copy, $3.50 in microfiche. USGS Open-File Report 83-39, September 1982. 152 p, 8 Fig, 2 Tab, 5 Ref.

Descriptors: Geologic units, Well water, *Well data, *Groundwater, *Water quality data, Ada County, Canyon County, Elmore County, Owyhee County, Snake River Basin, Western Snake River Plain, *Idaho.

Well-inventory and groundwater-quality data for 665 sites with a total of 1,318 chemical analyses were compiled from Elmore, Owyhee, Ada, and Canyon Counties. Data are sorted by water temperature (less than 20 degrees Celsius is considered nonthermal; 20 degrees Celcius or greater is considered thermal) to facilitate their use. (USGS)
W84-00834

FUNDING HISTORY OF THE U.S. GEOLOGICAL SURVEY FEDERAL DATA COLLECTION AND ANALYSIS PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 9D.
W84-00836

FLOODS OF NOVEMBER 1978 TO MARCH 1979 IN ARIZONA AND WEST-CENTRAL NEW MEXICO,
Geological Survey, Tucson, AZ. Water Resources Div.
B. N. Aldridge, and T. A. Hales.
USGS Open-File Report 83-201, April 1983. 168 p, 13 Fig, 10 Tab, 38 Ref.

Descriptors: *Floods, *Flood damage, Hydrographs, *Peak discharges, *Regulated flow, *Reservoir storage, Discharge(Water), Historic floods, Precipitation(Atmospheric), Reservoir operation, Stream erosion, Streamflow, Surface runoff, Traveltime(Floods), *Gila River, Little Colorado River Maricopa County, Phoenix, Salt River, Santa Cruz River, San Pedro River, Verde River, San Francisco River, Duncan, Clifton, Safford, Winslow, Gila Hot Springs, *Arizona, *New Mexico.

Widespread rainfall of 3 to 9 inches in the mountains area of Arizona and West-Central New Mexico during December 17-20, 1978, caused maximum known discharges on the Gila River in New Mexico and on several streams in Arizona. At Phoenix, the Salt River was the highest since 1920 but was only slightly higher than the flood in March 1978. The Agua Fria River was the highest since 1919. The floods caused 12 deaths and more than $150 million in damage. Damage of $51.8 million occurred in Maricopa County, Arizona. Ten counties in Arizona and three counties in New Mexico wer declared disaster areas. Unusually high volumes of runoff occurred on the Salt, Verde, and Agua Fria Rivers upstream from reservoirs. Overflow from the reservoir systems caused flooding downstream. Storage in the reservoirs on the Salt and Verde River reduced the peak discharge of the Salt River at Phoenix from a potential of about 234,000 cubic feet per second to 126,00 cubic feet per second and greatly reduced the duration of the flood. (USGS)
W84-00837

RAINFALL-RUNOFF DATA FROM SMALL WATERSHEDS IN COLORADO, OCTOBER 1977 THROUGH SEPTEMBER 1980,
Geological Survey, Lakewood, CO. Water Resources Div.
B. J. Cochran, D. R. Minges, D. Jarrett, and J. E. Veenhuis.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $98.00 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-873, 1983. 748 p, 3 Fig, 4 Tab, 17 Ref.

Descriptors: Floodwater, Hydrographs, *Rainfall-runoff relationships, Runoff coefficient, *Small watersheds, Storm runoff, Surface runoff, Time of concentration, Unit hydrographs, Cloudbursts, Rainfall, Rainfall intensity, Flash floods, Precipitation intensity, *Data collection, *Colorado, Denver, Boulder, South Platte River basin, Arkansas River basin, Colorado River basin.

Rainfall-runoff data from small watersheds in Colorado are being collected and analyzed for the purpose of defining the flood characteristics of these and other similar areas. Rainfall-runoff collected from October 1977 through September 1980 at a total of 37 urban stations, 10 Denver Federal Center stations, and 41 rural (or highway) stations are presented in tabular form along with station descriptions and methods of data collection and analysis. (USGS)
W84-00858

HYDROLOGIC DATA FOR URBAN STORM RUNOFF IN THE DENVER METROPOLITAN AREA, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. W. Gibb, and J. T. Doerfer.
Available from the OFSS, USGS, Lakewood CO 80225, Price: $77.50 in paper copy, $4.50 in microfiche. USGS Open-File Report 82-872, September 1982. 553 p, 3 Fig, 380 Tab, 9 Ref.

Descriptors: *Storm runoff, *Rainfall-runoff relationships, Rainfall-runoff modeling data, Water-quality data, Rainfall-runoff simulation data, *Hydrologic data, *Urban runoff, *Colorado, Denver Metropolitan area, Denver Regional Council of Governments, South Platte River.

Urban storm-runoff data collected from April through September 1981 from nine Denver Nationwide Urban Runoff Program sites, urban storm-runoff data collected from April 1980 through September 1981 from ten South Platte River Study sites, and rainfall-runoff simulation data from two sites for June 1980 and May 1981 are presented in this report. The Denver Nationwide Urban Runoff Program sites were two single-family residential areas, two multifamily residential areas, one commercial area (shopping center), one mixed commercial and multifamily residential area, one natural area (open space), and two detention ponds. The South Platte River Study sites were six tributaries of the South Platte River and four in-stream sites on the South Platte River. The tributary sites were Bear Creek at mouth, at Sheridan; Harvard Gulch at Harvard Park, at Denver; Sanderson Gulch at mouth, at Denver; Weir Gulch at mouth, at Denver; Lakewood Gulch at mouth, at Denver; and Cherry Creek at Denver. The in-stream sites were South Platte River at Littleton; South Platte River at Florida Avenue, at Denver; South Platte River at Denver; and South Platte River at 50th Avenue, at Denver. The rainfall-runoff simulation sites were North Avenue at Denver Federal Center, at Lakewood and Rooney Gulch at Rooney Ranch, near Morrison. Precipitation, rainfall-runoff, water-quality data, and basin characteristics were collected at the urban storm-runoff sites. The urban storm-runoff data may be used to characterize runoff loading for various land-use types in Denver and other semiarid regions. (USGS)
W84-00859

WATER QUALITY OF THE POTOMAC RIVER AT CHAIN BRIDGE AT WASHINGTON, D.C., HYDROLOGIC DATA REPORT, 1978 WATER YEAR,
Geological Survey, Reston, VA. Water Resources Div.
S. F. Blanchard.
USGS Open-File Report 83-147, 10 p, 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Water quality data, *Hydrologic data, *Potomac River, Potomac estuary study.

Water quality data are presented, measured at the Potomac River at Chain Bridge at Washington, D.C. for the 1978 water year. Samples were generally collected twice a week and more frequently during periods of high flow. The samples were analyzed for nitrogen, phosphorus, silica and suspended sediments. (USGS)
W84-00861

WATER-RESOURCES INVESTIGATIONS OF THE U. S. GEOLOGICAL SURVEY IN MISSOURI, FISCAL YEAR 1983,
Geological Survey, Rolla, MO. Water Resources Div.
W. M. Kratzer.
USGS Open-File Report 83-251, 1983. 51 p, 3 Fig, 1 Tab, 150 Ref.

Descriptors: *Missouri, *Hydrologic-data program, Networks, Streamflow-gaging stations, *Data collection, District projects, Hydrologic reports.

Water-resources investigations of the U.S. Geological Survey in Missouri consist of collecting hydrologic data and making interpretive investigations. These data and the results of the investigations are published or released by either the U.S. Geological Survey or by cooperating agencies. This report describes the data-collection activities and investigations in Missouri for the 1983 fiscal year and provides an extensive list of water-resources references for the State of Missouri. (USGS)
W84-00862

SELECTIVE ANNOTATED BIBLIOGRAPHY OF GROUND-WATER RESOURCES, RECORDS OF WELLS AND SPRINGS, AND AVAILABILITY OF STREAMFLOW DATA ON INDIAN RESERVATIONS IN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings, and M. K. White.
USGS Open-File Report 83-129, March 1983. 141 p, 4 Fig, 61 Ref.

Descriptors: *Groundwater, Surface water, *Indian Reservations, *Hydrologic data, *Data collection, *Montana, Blackfeet Indian Reservation, Crow Indian Reservation, Flathead Indian Reservation, Northern Cheyenne Indian Reservation, Rocky Boys Indian Reservation.

A compilation was made, for each of the seven Indian reservations in Montana, of the availability of hydrologic data. The report consists of an annotated bibliography of ground-water resources reports, selected data for wells and springs from the data bases of the U.S. Geological Survey and Montana Bureau of Mines and Geology, and a listing of all sites where streamflow has been measured and water-quality samples collected by the U. S.Geological Survey. (USGS)
W84-00863

GEOHYDROLOGIC DATA FROM SANDSTONE AQUIFERS IN SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
J. Kume, and J. M. Spinazola.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $15.00 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-868, 1982, 112 p, 3 Fig, 6 Tab, 20 Ref.

Descriptors: *Hydrologic data, Sandstones, *Aquifers, Geology, Lithologic logs, Chemical analysis, Water level, *Sandstone aquifers, *Kansas.

Data collected during a reconnaissance i
tion of the geology and hydrology of s
aquifers provide useful information in the
and planning for, water-resources develo
a 17,400 square-mile area in 26 counties
western Kansas. The aquifers consist c
saturated sandstones that occur in Upper
Upper Jurassic, and Lower and Upper Cr
rocks. In parts of southwestern Kansas,
stone aquifers already serve as the prin
secondary source of ground water for i
and other uses. Data indicate that water
available for development in sandstone aq
other parts of the study area. In still oth
water from wells in sandstone aquifers ma
of a suitable quality for some purposes.
provided include records of selected wells
gic logs of test holes and wells, selected f
surfaces and sandstone thicknesses, chemic
ses of water from selected wells, and wat
in observation wells. (USGS)
W84-00864

**GROUND-WATER LEVELS IN SEL
WELL FIELDS AND IN WEST-CE
FLORIDA, MAY 1982,**
Geological Survey, Tallahassee, FL. W
sources Div.
G. L. Barr.
Available from the OFSS, USGS Lakewo
80225, Price $7.00 in paper copy, $1.00 i
fiche. USGS Open-File Report 82-867,
Maps, 2 Tab, 2 Ref.

Descriptors: *Aquifers, *Groundwaters, P
metric level, Subsurface waters, *Wate
*Florida, Floridan aquifer, Surficial
*Maps.

The water table in the surficial aquifer
potentiometric surface of the Floridan aqu
1,700-square-mile area in west-central Flo
mapped semiannually by the U.S. Ge
Survey. Maps are based on water levels m
in wells each May to coincide with the
low levels and each September to coinci
seasonal high levels. The mapped area sh
well fields that supplied 181.1 million ga
municipalities on May 10, 1982. The water
drawn from the Floridan aquifer, the majo
in Florida. The effect of localized withdr
ground water is shown on the maps as dep
in both the potentiometric and water-ta
faces. In May 1982, ground-water leve
lower than those of September 1981. Seas
charge from above-average rainfall and
pumpage aided in the water-level recove
record to near record levels of May 1981.
W84-00867

**DRAINAGE DIVIDES, MASSACHUS
TAUNTON RIVER BASIN AND SOUT
COASTAL BASINS,**
Geological Survey, Boston, MA. Water Re
Div.
S. Wandle, Jr., and M. H. Frimpter.
USGS Open-File Report, 82-870, 1982. 21
Fig.

Descriptors: *Drainage basins, *Surface
*Massachusetts, Sites, Hydrologic data,
Taunton River, Tenmile River, Charles
Buzzards Bay tributaries, Mount Hope Ba
taries, Narragansett Bay tributaries, Bristol,

Drainage boundaries for selected subbasins
Taunton River basin and Southeast Coastal
in Bristol, western Norfolk, western Ply
southern Middlesex and eastern Worceste
ties, Massachusetts, are delineated on 24
graphic quadrangle maps at a scale of 1
Drainage basins are shown for all U.S. Geo
Survey data-collection sites and for mo
major rivers. Drainage basins are shown
outlets of lakes or ponds and for streams wh
drainage area is greater than 3 square
Successive sites along watercourses are in
where the intervening area is at least 6 squa
on tributary streams or 10 square miles alo
Charles River, Taunton River, or Tenmile
(USGS)
W84-00868

ISTICAL SUMMARIES OF SELECTED MICAL CONSTITUENTS IN KANSAS UND-WATER SUPPLIES,
gical Survey, Lawrence, KS. Water Re-es Div.
rimary bibliographic entry see Field 2F.
0849

UND-WATER LEVELS IN ARKANSAS, NG 1982,
gical Survey, Little Rock, AR. Water Re-es Div.
ds.
Open-File Report 83-268, 1983. 49 p, 5 Fig, b, 18 Ref.

iptors: *Groundwater level, Aquifers, Well graphs, Potentiometric level, *Arkansas, Al- aquifer, Sparta sand, Potentiometric-surface

640 ground-water level measurements were in observation wells in Arkansas in the of 1981. In addition, the report contains iometric-surface maps and well hydrographs g to the alluvial aquifer and the Sparta Sand, nost important aquifers with respect to d-water availability and use in Arkansas. S)
0870

UAL WATER-RESOURCES REVIEW, E SANDS MISSILE RANGE, NEW CO, 1981,
gical Survey, Albuquerque, NM. Water Re-s Div.
imary bibliographic entry see Field 2F.
0872

UND-WATER DATA FOR MICHIGAN,
gical Survey, Lansing, MI. Water Resources
Huffman.
Open-File Report 82-754, 1982. 55 p, 22 Tab, 90 Ref.

ptors: Water resources, *Groundwater, ndwater hydrographs, Water levels, Water ater quality, *Michigan.

eport summarizes data on water levels in 124 ation wells and provides information on ocations, depths, altitudes, and aquifers that p. Tabulated data include extremes of water for 1981 and for the period of record, pum- of most major ground-water users in the and quality data on selected wells. The city nsing was the largest reported user of d-water, pumping 8.6 billion gallons from the w Formation and glacial deposits. (USGS)
0875

NTIOMETRIC-SURFACE MAP OF R IN THE JUDITH RIVER FORMATION IE NORTHERN GREAT PLAINS AREA ONTANA,
gical Survey, Helena, MT. Water Resources
Levings.
ble from the USGS, OFSS Lakewood, CO Price: $2.25 in paper copy, $1.00 in micro- USGS Open-File Report 82-562, 1982. 1 map, 1 Fig, 7 Ref.

ptors: *Groundwater, *Potentiometric level, rs, Judith River Formation, Northern Great *Montana, *Maps.

otentiometric surface of the Judith River tion is mapped at a scale of 1:1,000,000. The s one of a series produced as part of a al study of aquifers of Cenozoic and Meso- ge in the northern Great Plains of Montana. ontour interval is 200 feet. Water in the River Formation occurs under water-table tesian conditions. The direction of regional d-water movement is from west to east. is discharged from the Judith River Forma- tion to the Milk River from near Havre, Montana, to Malta and to the Missouri River south of the Bearpaw and Little Rocky Mountains. The average discharge from 236 wells is about 10 gallons per minute, and the specific capacity of 186 wells averages 0.66 gallon per minute per foot of drawdown. (USGS)
W84-00877

POTENTIOMETRIC-SURFACE MAP OF WATER IN THE LAKOTA FORMATION AND EQUIVALENT UNITS IN THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $2.25 in paper copy, $1.00 in microfiche. USGS Open-File 82-563, 1982. 1 Sheet Map, 1 Fig, 4 Ref.

Descriptors: *Groundwater, *Potentiometric level, *Aquifers, Lakota Sandstone, Cut Bank Sandstone Member, Sunburst Sandstone Member, Moulton Member of Kootenai Formation, Third Cat Creek sandstone of Kootenai Formation, Pryor Conglomerate Member of Cloverly Formation, *Montana, *Maps.

The potentiometric surface of water in the lower Cretaceous Lakota Formation and equivalent units (Cut Bank Sandstone Member, Sunburst Sandstone Member, and Moulton Member of Kootenai formation; Third Cat Creek sandstone of Kootenai Formation; Pryor Conglomerate Member of Kootenai Formation) is shown on a base at a scale of 1:1,000,000. The map is one of a series produced as part of a regional study of aquifers of Cenozoic and Mesozoic age in the northern Great Plains of Montana. The contour interval is 200 feet. Water in the Lakota Formation and equivalent units occurs under water-table and artesian conditions. The direction of regional groundwater movement is east and north from the recharge areas in the Little Belt and Big Snowy Mountains. The average discharge from 20 wells is about 29 gallons per minute and the specific capacity of 18 wells averages 0.75 gallon per minute per foot of drawdown.
W84-00881

BASELINE WATER-QUALITY DATA FOR SAND-PLAIN AQUIFERS IN HUBBARD, MORRISON, OTTER TAIL, AND WADENA COUNTIES, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
C. F. Myette.
Available from the OFSS, USGS, Lakewood, CO 80225; Paper copy $14.25, Microfiche $3.50. USGS Open-File Report 82-909, October, 1982. 112 p, 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Baseline studies, Water quality data, Sand aquifers, Hubbard County, Morrison County, Otter Tail County, Wadena County, *Minnesota, *Pollutant identification.

Tapping the surficial sand-plain aquifers in west-central Minnesota has raised the possibility for degradation of water quality. The sand-plain areas are generally overlain by sandy soils that permit rapid infiltration of precipitation and, possibly, of surface contaminants. One hundred twenty-five wells were sampled in Hubbard, Morrison, Otter Tail, and Wadena Counties during 1979-81 to establish regional baseline water quality. The wells were chosen to provide optimum areal coverage based on geology, direction of ground-water flow, and extent of aquifer development. Water from the sand-plain aquifers is of the calcium bicarbonate type. The water is hard to very hard with dissolved solids ranging from about 100 to 700 milligrams per liter. Locally, concentrations of dissolved solids, iron, manganese, and nitrate exceeded limits recommended by the Minnesota Pollution Control Agency. (USGS)
W84-00882

FLOODS OF DECEMBER 1982 AND JANUARY 1983 IN CENTRAL AND SOUTHERN MISSISSIPPI RIVER BASIN,
Geological Survey, Atlanta, GA. Water Resources Div.
V. B. Sauer, and J. M. Fulford.
USGS Open-File Report 83-213. 41 p, 14 Fig, 2 Tab, 10 Ref.

Descriptors: *Floods, *Flood data, *Regional floods, Flood hydrographs, Flood peak, Flood frequency, *Mississippi River Basin, Illinois, Missouri, Arkansas, Louisiana, Mississippi, Tennessee.

Widespread flooding occurred in December 1982, and January 1983, through a large part of the Central and Southern Mississippi River Basin. The States affected the most by these floods were Illinois, Missouri, Arkansas, Louisiana, Mississippi, and Tennessee. Two major storm periods occurred; one in early December and the other in late December. The early December storm resulted in outstanding floods mainly in Illinois, Missouri, and Arkansas. The late December storm produced major flooding mainly in Southeastern Arkansas, Louisiana, and Mississippi. Western Tennessee was on the fringes of both storms. Throughout the affected area for both storms, many streams exceeded previously known flood heights and discharges, and in many cases the recurrence interval of peak discharges exceeded 100 years. (USGS)
W84-00886

DISCHARGE DATA AT WATER-QUALITY MONITORING STATIONS IN ARKANSAS, 1980 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
R. K. Knott.
USGS Open-File Report 83-214, 1983. 36 p, 4 Tab.

Descriptors: *Streamflow, *Discharge measurement, *Arkansas, Water pollution control, Monitoring stations.

Discharge data were computed for a network of water-quality monitoring stations operated by the Arkansas Department of Pollution Control and Ecology (ADPC and E). All stations in the network were visited by Geological Survey personnel. Discharges on days of sampling were determined for 83 of the sites. A summary table of those discharges for the water year 1981 is given. Several discharges at three stations for miscellaneous dates in the 1980 water year are shown. Several discharges at four stations for miscellaneous dates in the 1979 year are shown. Several discharges at one station for miscellaneous dates in the 1978 water year are also shown. The letter-digit station numbers and names were devised and assigned by the ADPC and E. The corresponding eight-digit numbers are assigned downstream-order station numbers as used by the Geological Survey. (USGS)
W84-00887

RESULTS OF PESTICIDE SAMPLING IN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
M. W. Gaydos.
Available from the OFSS, USGS, BOX 25, Denver, CO 80225, Price: $3.25 in paper copy, $4.00 in microfiche. USGS Open-File Report 83-148, 1983. 22 p, 1 Fig, 3 Tab, 3 Ref.

Descriptors: r samples, Bottom material samples, *Tennessee.

Pesticide data were collected at twelve sites in Tennessee between August 1979 and July 1982. Although pes
W84-00889

WATER-QUALITY DATA FOR SMITH AND BYBEE LAKES; PORTLAND, OREGON, JUNE TO NOVEMBER, 1982,
Geological Survey, Portland, OR. Water Resources Div.
D. G. Clifton.
USGS Open-File Report 83-204, 1983. 56 p, 5 Fig, 11 Tab, 23 Ref.

Descriptors: *Water quality, Limnology, *Bottom sediments, Smith Lake, Bybee Lake, Columbia Slough, *Oregon, Portland.

Water-quality monitoring at Smith and Bybee Lakes included measurement of water temperature, dissolved oxygen concentration and percent saturation, pH, specific conductance, lake depth, alkalinity, dissolved carbon, total dissolved solids, secchi disk light transparency, nutrients, and chlorophyll a and b. In addition, phytoplankton, zooplankton, and benthic invertebrate populations were identified and enumerated. Lakebed sediment was analyzed for particle size, volatile solids, immediate oxygen demand, trace metals, total organic carbon, nutrients, and organic constituents. (USGS)
W84-00890

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS-OKLAHOMA, 1982 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
T. E. Lamb, and M. A. Moore.
Available from the OFSS, USGS, Box 25, Denver, CO 80225, Price: $3.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 83-46, 1983. 25 p, 1 Fig, 3 Tab, 2 Ref.

Descriptors: Interstate compacts, *Arkansas, *Oklahoma, *Stream discharge, Reservoir storage, *Streamflow, Annual yield, River basin, *Arkansas River Basin.

The computed annual yield and deficiency of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma, are given in tables. Actual runoff from the subbasins and depletion caused by major reservoirs in the compact area are also given in tabular form. Monthly, maximum, minimum, and mean discharges are shown for the 14 streamflow stations used in computing annual yield. (USGS)
W84-00891

ESTIMATED WATER USE IN SOUTHWEST FLORIDA, 1981, AND SUMMARY OF ANNUAL WATER USE, 1970, 1975, AND 1977-81,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. D. Duerr, and J. E. Sohm.
USGS Open-File Report 83-45, 1983. 75 p, 28 Fig, 9 Tab, 17 Ref.

Descriptors: *Water use, Irrigation water, Industrial water, Municipal water, *Estimated water use, *Florida, Southwest Florida Water Management District.

Water-use data for 1981 are summarized for 16 counties in the Southwest Florida Water Management District. Data include total use of groundwater and surface water for each of five water-use categories. The 1981 withdrawals for each category were as follows: 318 million gallons per day for public supply, 64 million gallons per day for rural, 314 million gallons per day for industrial, 595 million gallons per day for irrigation, and 7,680 million gallons per day for thermoelectric power generation of which 6,050 million gallons per day was saline water. (USGS)
W84-00892

ESTIMATED WATER USE IN MISSOURI, 1980,
Geological Survey, Rolla, MO. Water Resources Div.
M. Marikos, and J. Skelton.
Missouri Department of Natural Resources, Rolla, 1983. 1 Sheet Map, 14 Fig, 1 Tab, 7 Ref.

Descriptors: *Water use, *Consumptive use, Groundwater, Surface water, Irrigation, Industrial water use, *Maps, *Missouri, Public supply, Rural use, Thermoelectric use, Total use.

The map report summarizes 1980 water-use data for Missouri by counties for the following categories: public supply, rural (self-supplied), irrigation, thermoelectric, and industrial (self-supplied), irrigation, thermoelectric, and industrial (self-supplied). Total use during 1980 was about 6,345 million gallons per day. About 92.5% was withdrawn from surface-water sources and the rest from ground-water sources. Total water use increased by 81% during 1970-80, but population increased only about 5%. The major increase in use during 1970-80 was by thermoelectric powerplants, with small increases in public-supply withdrawals and irrigation. Rural and industrial use remained almost constant. (USGS)
W84-00894

TIME OF TRAVEL OF SELECTED ARKANSAS STREAMS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-00895

A TWO-DIMENSIONAL FINITE-ELEMENT MODEL STUDY OF BACKWATER AND FLOW DISTRIBUTION AT THE I-10 CROSSING OF THE PEARL RIVER NEAR SLIDELL, LOUISIANA,
Geological Survey, Bay Saint Louis, MS. Water Resources Div.
For primary bibliographic entry see Field 2A.
W84-00896

QUALITY-ASSURANCE DATA FOR ROUTINE WATER ANALYSIS IN THE LABORATORIES OF THE U.S. GEOLOGICAL SURVEY: 1981 ANNUAL REPORT,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W84-00897

CONSUMPTIVE USE OF FRESHWATER IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
S. D. Leach.
Florida Department of Natural Resources, 1982. 1 Sheet Map, 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Florida, *Water use, *Consumptive use, Freshwater, *Public supply, Rural water, Industrial water, Irrigation, Thermoelectric water use, Hydrology, *Maps.

Freshwater withdrawn in Florida for all uses averaged 7,309 million gallons per day (Mgal/d) in 1980. Of this amount, 4,831 Mgal/d was returned for reuse and 2,478 Mgal/d or one third of the freshwater withdrawn was consumed. The greatest use of freshwater was 2,997 Mgal/d prepared for irrigation, which had the greatest consumptive use of 1,547 Mgal/d, including an estimated 18 Mgal/d for conveyance loss. Consumptive use from irrigation was 62% of the total consumptive use statewide. Thermoelectric power generation, with an average withdrawal of 1,859 Mgal/d, was the second greatest user of freshwater, but had the least consumptive use of only 32.8 Mgal/d. The remaining consumptive use of freshwater amounted to 329 Mgal/d from public supplies, 102 Mgal/d from rural domestic and livestock use, and 467 Mgal/d from self-supplied industries. Consumptive use of water is a prime measure of the effect of water use upon the water budget in the State. As the total amount of freshwater withdrawn each year increases so will the amount of consumptive use. (USGS)
W84-00898

WATER QUALITY OF THE BARATARIA MARSH UNIT, JEAN LAFITTE NATIONAL HISTORIC PARK, LOUISIANA (APRIL 1981-MARCH 1982),
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. R. Garrison.
USGS Open-File Report 82-691, 1982. 34 p, 2 Fig, 5 Tab, 16 Ref.

Descriptors: *Water quality, *Data coll
Physical analysis, Biological properties, *D
lections, Physical analysis, Biological pro
Chemical analysis, Nutrients, *Pesticides, J
fitte National Historic Park, *Louisiana, Ba
Westwego, Crown Point, Bayou Segnette
Canal, Millaudon Canal.

Surface-water samples were collected on a
ly basis for the period April 1981-March 19
six sites within the Barataria Marsh Unit
Jean Lafitte National Historic Park, Lo
The sites were located on Bayou Segnette
Canal, and Millaudon Canal. Biological, ch
and physical analyses were performed. T
the sites were sampled quarterly for ad
parameters including pesticides, metals,
growth potential, phytoplankton, benthic
brates, and grain size of bed material. The
of the analyses are presented without inte
tion. (USGS)
W84-00900

**GEOLOGIC AND WELL-CONSTRUC
DATA FOR THE H-10 BOREHOLE COM
NEAR THE PROPOSED WASTE ISOLA
PILOT PLANT SITE, SOUTHEASTERN
MEXICO,**
Geological Survey, Albuquerque, NM. Wa
sources Div.
For primary bibliographic entry see Field 5E
W84-00901

**DRAINAGE DIVIDES, MASSACHUS
CONNECTICUT RIVER LOWLANDS
CHICOPEE RIVER BASIN,**
Geological Survey, Boston, MA. Water Res
Div.
B. E. Krejmas, and S. W. Wandle, Jr.
USGS Open-File Report 82-633, 1982. 18
maps, 1 Fig.

Descriptors: *Drainage basins, *Surface
*Massachusetts, Sites, Hydrologic data,
*Connecticut River, Chicopee River, Fr
County, Hampshire County, Worcester C

Drainage boundaries for selected subbasins
Connecticut River lowlands and Chicopee
basin in southern Franklin, eastern Hampshir
western Worcester Counties, Massachusett
delineated on 18 topographic quadrangle ma
scale of 1:24,000. Drainage basins are shown
U.S. Geological Survey data-collection site
for mouths of major rivers. Drainage basi
shown for the outlets of lakes or ponds a
streams where the drainage area is greater t
square miles. Successive sites along waterc
are indicated where the intervening area is a
6 square miles on tributary streams or 10 s
miles along the Chicopee River, or 20 square
along the Connecticut River. (USGS)
W84-00902

**POTENTIOMETRIC-SURFACE MAP
WATER IN THE FOX HILLS LOWER H
CREEK AQUIFER IN THE NORTH
GREAT PLAINS ARE OF MONTANA,**
Geological Survey, Helena, MT. Water Reso
Div.
G. W. Levings.
Available from the USGS, OFSS, Lakewood
80225, Printed copy $2.25, Microfiche $
USGS Open-file Report 82-564, 1982. 1 S
maps, 1 Fig, 4 Ref.

Descriptors: *Groundwater, *Potentiometric
*Aquifers, Fox Hill-lower Hell Creek aquifer,
Hills sandstone, Hell Creek formation, Nort
Great Plains, *Montana, *Maps.

The potentiometric surface of water in the U
Cretaceous Fox Hills-lower Hell Creek aqui
shown on a base map at a scale of 1:1,000,000.
map is one of a series produced as part of reg
study of aquifers of Cenozoic and Mesozoic a
the northern Great Plains of Montana. The
tour interval is 100 feet. The map shows tha
direction of regional ground-water moveme
toward the northeast. Recharge occurs on

of the Black Hills uplift, the Cedar Creek
ine, the southwest part of the Bull Mountains
and on the out-crop areas. Discharge from
uifer occurs along a short reach of the Yel-
one River. The average discharge from 335
is about 16 gallons per minute and the specif-
acity of 185 wells averages 0.49 gallon per
e per foot of drawdown. (USGS)
00903

**NAGE AREAS IN NEW JERSEY: DELA-
E RIVER BASIN AND STREAMS TRIBU-
TO DELAWARE BAY,**
gical Survey, Trenton, NJ. Water Resources

Velnich.
ble from the USGS, OFSS, Lakewood, CO
Price: $6.50 in paper copy, $3.50 in micro-
USGS Open-File Report 82-572, August
48 p, 1 Fig, 3 Tab, 5 Ref.

ptors: *Drainage area, *Watersheds(Basin),
g stations, Rivers, Drainage system, Surface
*Delaware River, *New Jersey, Basin char-
tics, Stream gazaetteer.

ge areas of New Jersey streams tributary to
elaware River and Delaware Bay are listed
er 1,100 sites. Tables show the descriptive
n of each site, the latitude and longitude,
, and National Topographic map name. For
sites established through 1980, the U.S. Geo-
Survey station name and number are also
The data are presented alphabetically by
name and in downstream order. Drainage
were tabulated for most named streams and
ed streams with a drainage area greater than
re miles. The methods used to delineate the
ge divides, measure areas, and determine
of streams follow the guidelines developed
U.S. Water Resources Council. (USGS)
00904

**OLOGY OF THE HAMILTON LAKES
VICINITY, POLK COUNTY, CENTRAL
IDA,**
gical Survey, Tallahassee, FL. Water Re-
Div.
derson, and E. P. Simonds.
Open-File Report 82-630, 1983. 1 Sheet
Fig, 4 Tab, 8 Ref.

ptors: *Lakes, Aquifers, *Sinkholes, Rain-
vaporation, Groundwater, *Lake levels,
quality, Basin, Control structures, *Florida,
est Florida Water Management district,
olidated sand, Clay, Peace River basin,
Hamilton Lakes.

milton lakes, headwaters of the eastern arm
Peace River drainage system, consist of
lamilton, Middle Lake Hamilton, and Little
amilton. The lakes, which are connected by
hat tend to equalize their levels, probably
coalesced sinkhole depressions. The drain-
in of Lake Hamilton contains several water-
structures which can alter the effective size
area contributing water to the Hamilton
cording to their gate settings. The chemical
logical conditions in the Hamilton lakes are
at the lakes are not sufficiently enriched to
roblems with excessive weed growth or
ooms. (USGS)
00905

**R QUALITY OF THE TIDAL RIVER
ESTUARY; HYDROLOGIC DATA
RT, 1981 WATER YEAR WITH A SEC-
ON CHLOROPHYLL-A: COLLECTION
NALYSIS,**
ical Survey, Reston, VA. Water Resources

anchard, R. H. Coupe, Jr., and J. C.
ard.
le from the USGS, OFSS, Lakewood, CO
Price: $39.50 in paper copy, $3.50 in micro-
SGS Open-File Report 82-575, 1982. 298 p,
Tab, 26 Ref, 3 Append.

Descriptors: *Hydrologic data, *Tidal Potomac River, *Water quality, *Potomac estuary study, *Chlorophyll-a analysis.

This report contains data on the physical and chemical properties measured in the Tidal Potomac River and Estuary during the 1981 water year. Data were collected at least weekly at five stations, and periodically at 15 stations and at two other stations near the mouth of the Potomac River in Chesapeake Bay. Each of the five stations represent a cross section at which the transport of selected dissolved and suspended materials can be computed. The remaining 17 stations are locations at which data were collected for special studies of selected phenomena, such as salt water migration and dissolved oxygen dynamics. Samples were routinely analyzed for chlorophyll-a, nitrogen, pheophytin, phosphorus, silica and suspended sediment. Additional samples were analyzed for adenosine triphosphate, algal growth potential, alkalinity, calcium, chloride, dissolved-solids residue, fluoride, iron, manganese, magnesium, nitrifying bacteria, organic carbon, potassium, seston, sodium, and sulfate. In addition, in-situ measurements of dissolved oxygen, specific conductance, pH, temperature, solar radiation, and secchi disk transparency were made. (USGS)
W84-00906

WATER QUALITY MONITORING - RIVERS AND STREAMS, 1982.
Indiana State Board of Health, Indianapolis. Div. of Water Pollution Control.
Report, 1982. 138 p, 6 Tab.

Descriptors: *Water sampling, *Water analysis, *Water measurement, Water pollution, *Water pollution control, *Water pollution effects, Water quality management, Water quality, Biological samples, Chemical analysis, Chemical composition, State jurisdiction, Municipal water, *Indiana.

A program in Indiana to provide basic information on pollution trends and to provide water quality data for the state's surface water users has been described in annual water quality reports. This report, the 25th, emphasizes the importance of surface water via the fact that two-thirds of the water usage in Indiana in 1980 was obtained from surface supplies. While 49 sites were sampled in 1952, 92 stations are included in the current program. Physical, chemical, and bacteriological analyses are made on samples collected from all 92 stations; plankton analyses from 18; and radiological analyses from 23. The forty-five methods of analyses used represent the minimum of bacteriological, chemical, and radiological analysis which would justify the collection program. The monitoring program is intended to indicate, when possible, the sources of pollution abatement programs, and to collect background data on certain types of waste, such as chlorides and radioactive materials. The monitoring stations are selected on the basis of having waters used for municipal, industrial, agricultural and recreational purposes; if they are near known or suspected sources of pollution; and when they are near state boundaries to determine the quality of water entering or leaving the state. Routine samples include 2,000 milliliters for chemical analysis and about 100 milliliters in a sterile bottle for bacteriological analysis. This year no flow data are included. (Garrison-Omniplan)
W84-00910

WATER-LEVEL MAPS OF THE ALLUVIAL AQUIFER, NORTHWESTERN MISSISSIPPI SEPTEMBER 1981,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
USGS Open-File Report 82-574, 1982. 1 Sheet map, 1 Fig, 6 Ref.

Descriptors: *Mississippi, *Groundwater, *Aquifers, *Water levels, Mississippi River valley alluvial aquifer, Quarternary aquifers, *Maps, Water wells.

Water levels were measured in 427 wells in the Mississippi River valley alluvial aquifer in northwestern Mississippi during the period September 15-28, 1981. Water levels in the alluvial sands and gravel were generally lower than water levels in September 1980 and larger depressions in the surface of the ground-water body were detected in the Sunflower-Leflore County area and in Humphreys County. These depressions are attributed to heavy pumping for irrigation and to less-than normal rainfall. Other smaller depressions are attributed to local heavy pumping. (USGS)
W84-00921

APPROXIMATE ALTITUDE OF WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON AREA, TEXAS, SPRING 1982,
Geological Survey, Austin, TX.
C. E. Ranzau, Jr., and J. L. Strause.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $1.00 in paper copy, $1.00 in microfiche. USGS Open-File Report 82-559, June 1982. 2 Sheet maps, 2 Fig, 1 Ref.

Descriptors: *Groundwater, Water levels, *Water-level fluctuations, Aquifers, *Maps, Harris County, Galveston County, *Texas.

These two maps show water levels in wells in the Houston, Texas area in (1) the Chicot aquifer, spring 1982 and (2) the Evangeline aquifer, spring 1982. Both the Chicot and Evangeline aquifers are composed of several sand layers with different potentiometric surfaces. These maps, however, show approximations of single potentiometric surfaces that represent composite hydraulic heads. (USGS)
W84-00922

MONTHLY LOW-FLOW CHARACTERISTICS OF GEORGIA STREAMS,
Geological Survey, Doraville, GA. Water Resources Div.
R. F. Carter, and J. D. Lewis.
USGS Open-File Report 82-560, 1982. 81 p, 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Flow variability, *Low flow, *Monthly frequency, Time sampling, *Streamflow, *Stream gages, *Georgia.

Statistics of monthly minimum flows are presented for 129 streamflow stations for each month of the year. Flow statistics provided are the log-Pearson Type III distribution. The probable magnitude of average standard errors due to time-sampling bias is tabulated. The average standard errors were found to be similar over a wide area comprising approximately the northern two-thirds of the State. In this area, the average standard error of estimate for a low-flow statistic with a recurrence interval of 20 years and estimated on the basis of 10 years of record is about 17%. In the southern third of the State, the average standard errors were found to lie in a narrow range, but were significantly greater than in the north. In the southern area, the average standard error of estimate for a low flow statistic with a recurrence interval of 20 years and estimated on the basis of 10 years of record is about 40%. (USGS)
W84-00923

GROUND WATER AND GEOLOGY OF MARQUETTE COUNTY, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00925

WATER QUALITY OF COAL DEPOSITS AND ABANDONED MINES, SAGINAW COUNTY, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
A. H. Handy.
USGS Open-File Report 82-511, 1982. 35 p, 7 Fig, 5 Tab, 12 Ref.

Descriptors: Water quality, *Groundwater, Streams, Wetlands, Trace elements, *Coal mines,

Mining, Glacial drift, Saginaw formation, St. Charles, Saginaw County, *Michigan.

Coal was last mined in Saginaw County, Michigan in 1950. Water from abandoned mines and from undisturbed coal-bearing beds in the Saginaw Formation is highly mineralized and contains high concentrations of iron. Compared to streams in the area, the water contains higher concentrations of at least 15 constituents including boron, phenol, lithium, strontium, and manganese. Water from abandoned mines and coal-bearing beds is a poor source of water for domestic, public, or agricultural uses. Large amounts of this highly mineralized ground water reaching local streams would have a deleterious effect on surface-water quality. (USGS)
W84-00926

DATA FOR GROUND-WATER TEST HOLE NEAR ZAMORA, CENTRAL VALLEY AQUIFER PROJECT, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
J. J. French, R. W. Page, and G. L. Bertoldi.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $12.25 in paper copy, $4.00 in microfiche. USGS Open-File Report 82-510, July, 1982. 72 p, 13 Tab, 16 Fig, 22 Ref.

Descriptors: Test holes, Electrical well logging, Radioactive well logging, Diatoms, Clay minerals, Piezometers, *Water level fluctuations, *Water quality, *Groundwater, Sacramento Valley, *California, Yolo County, Central Valley Aquifer Project.

Preliminary data are presented for the first of seven test holes drilled as a part of the Central Valley Aquifer Project which is part of the National Regional Aquifer Systems Analysis Program. The test hole was drilled in the SW 1/4 SE 1/4 sec. 34, T. 12 N., R. 1 E., Yolo County, California, about 3 miles northeast of the town of Zamora. Drilled to a depth of 2,500 feet below land surface, the hole is cased to a depth of 190 feet and equipped with three piezometer tubes to depths of 947, 1,401, and 2,125 feet. A 5-foot well screen is at the bottom of each piezometer. Eighteen cores and 68 sidewall cores were recovered. Laboratory tests were made for mineralogy, hydraulic conductivity, porosity, consolidation, grain-size distribution, Atterberg limits, X-ray diffraction, diatom identification, thermal conductivity, and chemical analysis of water. Geophysical and thermal gradient logs were made. The hole is sampled periodically for chemical analysis and measured for water level in the three tapped zones. This report presents methods used to obtain field samples, laboratory procedures, and the data obtained. (USGS)
W84-00927

WATER USE IN WISCONSIN, 1979,
Geological Survey, Madison, WI. Water Resources Div.
C. L. Lawrence, and R. R. Ellefson.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $13.25 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Open File Report 82-444, July 1982, 98 p, 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Water use, *Wisconsin, *Groundwater pumpage, *Municipal water, Domestic water, Industrial water, Irrigation water, Withdrawal, Wells, Electric powerplants, Water users, Water supply.

This report summarizes the uses of water in Wisconsin during 1979. It considers all uses except those not involving significant position movement such as recreation. The greatest single use of water, an instream use, was for hydroelectric power production. About 26 trillion gallons, or 93% was used for this purpose. Of the other 7% where water is pumped to a different location 81% (6% of all water use) was cooling water for thermoelectric powerplants. Withdrawals of surface water by public and private systems are for residential, industrial, commercial, irrigation, and stock uses. (USGS)
W84-00928

HYDROLOGIC DATA FROM MONITORING OF SALINE-WATER INTRUSION IN THE CAPE CORAL AREA, LEE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. J. Fitzpatrick.
Available from the OFSS, USGS, Lakewood CO 80225, Price: $6.75 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-772, 48 p, 19 Fig, 7 Tab, 2 Ref.

Descriptors: Aquifers, Water levels, Water quality, Observation wells, Lithology, *Saline water intrusion, *Florida, Lee County, Cape Coral, *Hydrologic data.

As a result of declining water levels and saltwater intrusion in the Cape Coral area, the U.S. Geological Survey, in cooperation with the City of Cape Coral, established a monitor well network in Cape Coral and adjacent areas in 1978. The network was designed to monitor water levels and water quality, to collect background data from water-bearing zones in the upper and lower parts of the Hawthorn Formation, the upper part of the Tampa Formation, and the surficial aquifer. A network of 34 wells tapping the artesian freshwater-bearing aquifer in the upper part of the Hawthorn Formation was established, and water-quality samples were collected and analyzed semiannually from 1978-80. Water levels in selected wells were monitored continuously or measured monthly, bimonthly, or semiannually for general trends. Thirty-six wells tapping the surficial and six wells tapping the artesian aquifer in the lower part of the Hawthorn Formation were constructed. Selected wells in these aquifers have also been monitored for water levels continuously, or at monthly, bimonthly, or semiannual intervals. Water-quality data were collected from selected wells for background information. Lithologic logs were prepared for 18 wells penetrating one or more of the three aquifers. (USGS)
W84-00935

FIELD DATA DESCRIBING THE MOVEMENT AND STORAGE OF SEDIMENT IN THE EAST FORK RIVER, WYOMING, PART IV. BED ELEVATIONS, 1980,
Geological Survey, Denver, CO. Water Resources Div.
R. H. Meade, R. M. Myrick, and W. W. Emmett.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $26.25 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-360, 1982. 197 p, 8 Fig, 47 Tab, 13 Ref.

Descriptors: *Alluvial channels, Aggradation, *Degradation, *Sediment transport, *Wyoming, East Fork River, Upper Green River basin.

Bed elevations were measured every 1 to 5 days during 10 consecutive weeks which included the peak snowmelt runoff, at 43 cross sections in a 1.83-kilometer reach of the East Fork River, Wyoming. Considerable scour and fill were recorded at many of the cross sections. (USGS)
W84-00936

FIELD DATA DESCRIBING THE MOVEMENT AND STORAGE OF SEDIMENT IN THE EAST FORK RIVER, WYOMING: PART III. RIVER HYDRAULICS AND SEDIMENT TRANSPORT, 1980,
Geological Survey, Denver, CO. Water Resources Div.
W. W. Emmett, R. M. Myrick, and R. H. Meade.
Available from the USGS, OFSS, Lakewood, CO 80225, Price: $38.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-359, 1982. 289 p, 9 Fig, 223 Tab, 23 Ref.

Descriptors: *Bedload, Bedload samplers, Fluvial sediment, *Geomorphology, Particle size, Rivers, Sediments, Sedimentation, *Sediment load, *Sediment transport, *Wyoming, East Fork River, Helley-Smith bedload sampler.

Frequent measurements of river stage, water discharge, sediment-transport rate and particle-size gradation, and river slope were made at sections along a 1.83-kilometer reach of River, Wyoming, during the spring 1980 runoff. Data are tabulated and explana facilitates its use for description of river h and sediment transport. (USGS)
W84-00937

WATER-QUALITY DATA FOR THE CAN RIVER BASIN, CALIFORNIA, ARY-OCTOBER 1979,
Geological Survey, Sacramento, CA. W sources Div.
J. M. Shay.
Available from the USGS, OFSS, Lakew 80225, Price: $7.75 in paper copy, $3.50 fiche. USGS Open-File Report 82-363 1982. 56 p, 1 Fig, 9 Tab, 8 Ref.

Descriptors: Biological properties, Chemi erties, Physical properties, *Water qual *Data collection, *California, America basin, Folsom Lake.

Data were collected in the American Ri from February to October 1979 for use in the water quality in the basin and develop use/water-quality relations. The basin cov square miles of the western slope of the Sierra Nevada. Basin headwaters are loc marily between Donner Summit and Summit. Water-quality data were collect stream sites and at 3 sites on Folsom L include selected measurements and anal physical, chemical, and biological proper constituents. (USGS)
W84-00938

ANNUAL SUMMARY OF GROUND-CONDITIONS IN ARIZONA, SPRING SPRING 1981.
Geological Survey, Tucson, AZ. Water R Div.
USGS Water-Resources Investigations O Report 82-368, March 1982. 2 Sheet Maps, Tab, 19 Ref.

Descriptors: Water levels, *Water-level ations, *Pumpage, Irrigation, *Groun *Maps, *Withdrawal, *Arizona, Basin and lowlands province, Central highlands p Plateau uplands province.

The withdrawal of ground water was ab million acre-feet in Arizona in 1980, which 600,000 acre-feet more than the amount wit in 1979. Although this amount is a sub increase from that withdrawn in 1978 and is less than the amount of ground wat annually since the mid-1960's and nearly equ to the amount used during the 1950's. Mos increase in 1980 was in the amount of water used for irrigation in the Basin and lowlands province. Through 1980, nearly lion acre-feet of ground water had been with from the ground-water reservoirs in Arizon report contains two small-scale maps that ground-water pumpage by areas and the st the ground-water inventory in the State. Th map, which is at a scale of 1:500,000, shows tial well production, depth to water in s wells in spring 1981, and change in water l selected wells from 1976 and 1981. A bri summarizes the current ground-water condit the State. (USGS)
W84-00941

HYDROLOGIC MONITORING IN THE OF THE PROPOSED YAZOO RIVER NA TION PROJECT, WEST CENTRAL MISSI PI, 1978-80,
Geological Survey, Jackson, MS. Water Res Div.
D. Darden.
USGS Open-File Report 82-369, 1982. 71 p, 4 Ref.

Descriptors: *Mississippi, *Environmental e *Inland waterways, *Groundwater Aquifers, Hydrographs, *Yazoo navigation

River, Mississippi River Valley alluvial Aquifers.

gic data on ground-water levels collected e area of the proposed Yazoo River Navi- roject for the years 1978-80 are presented interpretation. These data were obtained of a hydrologic study to understand the gic effects of construction and operation of way on the Yazoo River. The data were l in cooperation with the Vicksburg Dis- rps of Engineers, U.S. Army. During the lection period, water-level measurements ade on about a monthly schedule in 62 ion wells in the network. Three of the ere equipped with continuous water-level s. (USGS) 42

OF HYDROLOGIC DATA FOR SE- SITES IN BROWARD COUNTY, A, 1939-80,
al Survey, Tallahassee, FL. Water Re- Div.
enshein, J. E. Fish, C. R. Causaras, and ore.
OFSS, Lakewood, CO 80225, Price: $15.00 copy, $5.50 in microfiche. USGS Open- ort 82-920, 1982. 39 p, 4 Sheet maps, 6 b, 14 Ref.

rs: Hydrology, Geology, *Water quality, , *Florida, Broward County, Surficial Biscayne aquifer, *Maps.

rehensive assessment of the surficial of southeast Florida, including the Bis- uifer, was begun in 1979 by the U.S. al Survey, in cooperation with the South Water Management District. In the initial the study, an inventory was made of data available in the files of the U.S. l Survey and other public agencies of oward, and Palm Beach counties. This dexes through tables and maps, the ater quality, ground-water level, surface- ge, and geologic data bases for Broward USGS) 3

S OF SELECTED WELLS AND LITH- LOGS OF TEST HOLES, HENDRY AND ADJACENT AREAS, FLORIDA,
l Survey, Tallahassee, FL. Water Re- iv.
C. R. Causaras, and T. H. O'Donnell.
pen-File Report 83-134, 1983. 116 p, 5 , 3 Ref.

rs: *Well data, *Lithologic logs, Water *Florida, Hendry County, Surficial eep artesian aquifers.

e water-resource information for Hendry lorida, geologic test holes were drilled in al aquifer, and an extensive inventory iled of wells in the surficial aquifer and ian aquifers. This report provides: (1) r 788 selected wells and test holes in- cation, construction, water use, water oride concentration, specific conduc- perature, yield, hydrogen sulfide, and g problems; and (2) lithologic logs for es ranging in depth from 90 to 650 feet. entoried wells and two test holes are in parts of Collier or Glades Counties.

OGIC DATA FOR THE PELICAN NDS AQUIFER, WESTERN MINNE-
Survey, St. Paul, MN. Water Re- v.
r.
n-File Report 80-695, 1981. 86 p, 2 Fig, f.

s: *Groundwater, *Observation wells, vels, *Water quality, Aquifer, Draw- down, Data collections, Pump testing, *Basic data, *Pelican River, *Minnesota.

Hydrogeologic data for the Pelican River sands aquifer have been compiled in this report for use by the public and by State and local officials in making water development and management decisions. This report will supplement an interpretive report on the hydrogeology of the Pelican River sands aquifer that is scheduled for publication in 1981. The data which were collected in 1965, 1972, and 1978-79, include results of chemical analyses of water from selected wells, water-level measurements in wells, logs of test holes and observation wells, and results of aquifer tests. (USGS) W84-00947

DRAINAGE AREAS OF THE KANAWHA RIVER BASIN,
Geological Survey, Charleston, WV. Water Resources Div.
M. V. Mathes, D. D. Payne, Jr., and R. A. Shultz.
USGS Open-File Report 82-351, 1982. 222 p, 1 Fig, 2 Tab, 1 Ref.

Descriptors: *Drainage area, *River miles, *Data collection, *West Virginia, Kanawha River basin, *Data collection.

Drainage areas for 1,493 drainage area divisions for the Kanawha River basin, West Virginia, are listed in the report. Also tabulated for each site are river miles, plus location identifiers: County, latitude and longitude, and the West Virginia District map number. (USGS) W84-00948

POTENTIOMETRIC-SURFACE MAP OF WATER IN THE EAGLE SANDSTONE AND EQUIVALENT UNITS IN THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
USGS Open-File Report 82-565, 1982. 1 Sheet map, 1 Fig, 7 Ref.

Descriptors: *Groundwater, *Potentiometric level, *Aquifers, Eagle Sandstone, Virgelle Sandstone, Telegraph Creek Formation, *Montana, *Maps.

The potentiometric surface of water in the Upper Cretaceous Eagle Sandstone and equivalent units (Virgelle Sandstone and Telegraph Creek Formation) is shown on a base map at a scale of 1:1,000,000. The map is one of a series of maps produced as part of a regional study of aquifers of Cenozoic and Mesozoic age in the northern Great plains of Montana. The contour interval is 200 feet. The map shows that the directions of regional ground-water movement is from west to east except in the extreme northwestern corner where the movement is from east to west. Water is discharged from the Eagle Sandstone to the Missouri River south of the Bearpaw Mountains. In the area north of the Bearpaw Mountains, depressurization from gas production may account for the decline in the potentiometric surface. The average discharge from 115 wells is about 23 gallons per minute and the specific capacity of 85 wells averages 1.4 gallons per minute per foot of drawdown. (USGS) W84-00949

GROUND-WATER LEVELS IN WYOMING, 1971 THROUGH PART OF 1980,
Geological Survey, Cheyenne, WY. Water Resources Div.
J. O. Ragsdale.
USGS Open-File Report 82-859, 1982. 200 p, 171 Fig, 21 Tab, 7 Ref.

Descriptors: *Groundwater, Hydrographs, *Observations wells, Water-level recorders, *Wyoming, Cheyenne, Data collections.

Ground-water levels are measured periodically in a network of about 280 observation wells in Wyoming, mostly in areas where ground water is used in large quantities for irrigation or municipal purposes. The program is conducted by the U.S. Geological Survey in cooperation with the Wyoming State Engineer and the city of Cheyenne. This report contains maps showing the locations of selected wells, tables listing well histories and highest and lowest water levels for the period of record, and hydrographs for most of the wells. (USGS) W84-00950

DATA ON SUBSURFACE STORAGE OF LIQUID WASTE NEAR PENSACOLA, FLORIDA, 1963-1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. W. Hull, and J. B. Martin.
USGS, OFSS, Fed. Cntr., Lakewood, CO. 80225, Price: $24.00 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-689, 1982. 179 p, 10 Fig, 31 Tab, 40 Ref.

Descriptors: *Injection wells, *Underground waste disposal, Monitoring, Underground storage, Data collections, *Florida, *On-site monitoring wells, Facilities monitoring.

Since 1963, when industrial waste was first injected into the subsurface in northwest Florida, considerable data have been collected relating to the geochemistry of subsurface waste storage. This report presents hydrogeologic data on two subsurface waste storage. This report presents hydrogeologic data on two subsurface storage systems near Pensacola, Fla., which inject liquid industrial waste through deep wells into a saline aquifer. Injection sites are described giving a history of well construction, injection, and testing; geologic data from cores and grab samples; hydrographs of injection rates, volume, pressure, and water levels; and chemical and physical data from water-quality samples collected from injection and monitor wells. (USGS) W84-00951

WATER RESOURCES OF THE GUYANDOTTE RIVER BASIN, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
J. S. Bader, J. L. Chisholm, R. L. Bragg, and S. C. Downs.
West Virginia Geological and Economic Survey, Morgantown, Basic Data Report No 7, 1977. 550 p, 58 Fig, 13 Tab, 632 Ref.

Descriptors: *Flow characteristics, *Surface runoff, Geology, Surface-ground water relationships, *Chemical analyses, *Aquatic microbiology, *Waste disposal, Streamflow, Water quality, Water-pollution sources, Conductivity, *West Virginia, *Guyandotte River basin, 7-day, 10-year flow, *Well yield, Geologic structure, Coal-mining activities.

The 1975-78 water-resources study of the Guyandotte River basin, West Virginia is part of the continuing investigation of the water resources of the State's basins by the U.S. Geological Survey. The study, conducted in cooperation with the West Virginia Geological and Economic Survey and the West Virginia Department of Natural Resources, Division of Water Resources, includes an inventory of available water, water quality, and occurrence. Surface-water-runoff characteristics such as average runoff per year, 7-day 10-year flow, mean-annual streamflow, maximum flood discharge, and time of travel are described. An interpretive description of surface water quality, basin on chemical, biological, microbiological, and physical data collected at some 140 stream sites, is presented. Both the quantity and quality of ground water are related to control factors. The most important factors affecting well yields are shown to be geologic and topographic structure. Potential and existing water-quality problems, as related to ground water and surface water, are pointed out. (USGS) W84-00952

FLOODS OF OCTOBER 1977 IN SOUTHERN ARIZONA AND MARCH 1978 IN CENTRAL ARIZONA,

Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-00953

RECONNAISSANCE OF GROUND-WATER QUALITY, EASTERN SNAKE RIVER BASIN, IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00974

DATA FROM THE SURFACE-WATER HYDROLOGIC INVESTIGATIONS OF THE HAY CREEK STUDY AREA, MONTANA, AND THE WEST BRANCH ANTELOPE CREEK STUDY AREA, NORTH DAKOTA, OCTOBER 1976 THROUGH APRIL 1982,
Geological Survey, Bismarck, ND. Water Resources Div.
G. Douglas, S. W. Norbeck, and K. L. Boespflug.
USGS Open-File Report 83-136, February 1983. 273 p, 6 Fig, 9 Tab, 21 Ref.

Descriptors: *Hydrologic data, *Climatic data, *Montana, *North Dakota, Fort Union Coal Region, Hay Creek, West Branch Antelope Creek.

Data are provided for the Hay Creek study area near Wibaux, Montana, and the West Branch Antelope Creek study area near Beulah, North Dakota. The report contains data on the following: Air temperature, relative humidity, wind direction, wind run, solar radiation, precipitation, soil temperature, snowpack temperature, snowpack density and moisture content, streamflow, water quality, soil moisture, land use, and basin characteristics. Detailed descriptions of the location of the data-collection sites, instrumentation, and methods used to collect data are included. (USGS)
W84-00976

WATER RESOURCES OF BORREGO VALLEY AND VICINITY, CALIFORNIA, PHASE 1--DEFINITION OF GEOLOGIC AND HYDROLOGIC CHARACTERISTICS OF BASIN,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
W. R. Moyle, Jr.
USGS Open-File Report 82-855, November 1982. 39 p, 21 Fig, 8 Tab, 44 Ref.

Descriptors: Chemical analysis, Streamflow, Precipitation, Specific yield, Hydraulic conductivity, Transmissivity, Gravity, Land use, Hydrologic model, Borrego Valley, Clark Lake Valley, Borrego, Borrego Springs, Santa Rosa Mountains, Borrego Mountain, Anza-Borrego State Park, San Diego County, *California, *Withdrawal, *Groundwater depletion, *Groundwater storage.

This report is phase 1 of a 3-phase study and includes information needed to build a digital hydrologic model of Borrego Valley. It includes sources and amounts of recharge water to the basin, areas of water withdrawal, total ground water in storage at steady-state conditions (1945), net ground-water depletion, grid network used to determine storage and depletion, total depth of alluvial fill, transmissivity, hydraulic conductivity and specific yield of aquifers, thickness of individual aquifers, and chemical quality of water. (USGS)
W84-00980

JANUARY 1982 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst
Available from the USGS, OFSS, Fed. Center, Lakewood, CO 80225, Price: $21.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-649, 1982. 167 p, 2 Fig 1 Tab, 13 Ref.

Descriptors: *Groundwater, *Water-level changes, *Hydrologic data, *Kansas, Base-line studies.

Water-level measurements were made, mostly in January 1982, in about 1,530 wells in western and south-central Kansas. The measurements were made in mid-winter when pumping was minimal and water levels had recovered, for the most part, from the effects of pumping during the previous irrigation season. Annual hydrologic data are provided for relating water-level changes from a 'base-reference year' (predevelopment year), a year of abnormally high rainfall and minimum pumpage (1966 or 1974), and each of seven consecutive years of measurement (1976-82), the 'base-reference year' is designated as 1940 for the southwestern area, 1944 for the south-central area, and 1950 for the northwestern and west-central areas. Water levels for the 'base-reference year' are established by measurements made during that year and by interpretation of maps showing water-level altitudes. Data also are provided for relating the average annual water-level changes, saturated thicknesses of the deposits, and percentage changes in saturated thicknesses. (USGS)
W84-00981

QUALITY OF RUNOFF FROM SMALL WATERSHEDS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA--HYDROLOGIC DATA FOR 1980,
Geological Survey, St. Paul, MN. Water Resources Div.
G. A. Payne, M. A. Ayers, and R. G. Brown.
Available from the USGS, OFSS, Lakewood CO 80225, Price: $37.75 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-504, 1982. 289 p, 7 Fig, 17 Ref.

Descriptors: *Storm runoff, *Urban runoff, *Agricultural runoff, *Small watersheds, Urban hydrology, Land use, Storm water, Storm drains, Precipitation(Atmospheric), Antecedent precipitation, Rainfall intensity, Rain gages, Water quality, Twin Cities metropolitan area, *Minnesota.

An investigation of nonpoint-source runoff from small watersheds in the Twin Cities metropolitan area was conducted to define relationships between land use, watershed characteristics, and the quantity, quality, and timing of runoff. Six rural and four urban watersheds ranging in size from 1.22 to 82.9 square miles were studied. Discharge and water-quality data were collected at 19 sites during 1980. Recording instruments and automatic samplers provided continuous discharge records at 17 sites, continuous rainfall records and automatic collection of samples at 12 sites, and wetfall/dryfall precipitation samples at six sites. Sampling was intensified during periods of increased runoff resulting from snowmelt and rainstorms. Primary emphasis was placed on analysis of samples for suspended solids, nutrients, and chemical oxygen demand. Samples were also analyzed for chloride, metals, bacteria, and pesticides. The data are documented in tables containing basin characteristics and land use, daily and unit values for discharge and rainfall, rainfall characteristics, water-quality data for runoff and precipitation, results of laboratory settling test, results of quality assurance tests, daily loads, and storm loads. (USGS)
W84-00982

ATLAS OF ELEVEN SELECTED AQUIFERS IN NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
R. M. Waller, and A. J. Finch.
USGS Open-File Report 82-553, 1982. 255 p, 103 Fig, 11 Tab, 200 Ref.

Descriptors: *Groundwater, Unconsolidated aquifers, Groundwater movement, Glacial drift, Infiltration, Land use, Well yield, Surface-groundwater relations, Alluvium, Water use, *New York, *Atlas, *Aquifers.

Water from 11 aquifer systems in New York, excluding Long Island, is used by 2.8 million people. Ten are in areas hydraulically connected with the master stream and have a shallow water table, the 11th is a buried valley system on the Lake Ontario Plain. In all systems, till, lake silt and clay, and bedrock knobs are interspersed within sand and gravel. Confining conditions occur l systems and are extensive in some. partly urbanized, contains industry, extensive transportation network, all o be sources of contamination. Well yiel and industrial supply are commonly dred gallons per minute. More than 90 surficial geology, soil-zone permeabi dimensions and potential, water leve use; tables of ground-water use, popula and a summary of contamination poten given. Major concern in all areas is for contamination and, in a few areas, supply. The areas described are Schen dicott-Johnson City, Ramapo and Mah Irondequoit Creek, Jamestown, El heads-Big Flats, Cortland, Homer-Pre and Fishkill Creeks, Fulton, and south Woodbourne. (USGS)
W84-00983

GEOHYDROLOGY OF THE F AQUIFER IN THE WITHLACOOCH BASIN OF THE SOUTHWEST WATER MANAGEMENT DISTRICT,
Geological Survey, Orlando, FL. Wate Div.
W. Anderson, and C. P. Laughlin.
USGS Water-Resources Investigations Report 82-331, 1982. 4 Sheet maps, 17 24 Ref.

Descriptors: *Aquifers, Confining beds, *Groundwater, Potentiometric surfa quality, Quality, Basin, *Florida, *Maps, Unconsolidated deposits, Wit River.

The Withlacoochee River basin of the Florida Water Management District about 2,030 square miles in west-centr The basin is underlain by limestones t the Floridan aquifer, the principal sourc in the basin. In some parts of the basin, tiometric surface of the Floridan is bel of the aquifer. The Floridan is conside fined and under water-table conditions these parts even though locally, it is c unconsolidated deposits that may supp more perched aquifers. The Floridan a sidered unconfined in those parts overla meable deposits, even where the pote surface is above the top of the aquifer. dan is considered confined in those pa basin where it is overlain by impermeab and its potentiometric surface is abov Recharge to the Floridan in the basin is those parts that are internally drained a those parts where its permeability is lo face runoff occurs. The Floridan discha basin at springs and seeps in and near t coochee River. Water quality in the F generally excellent. However, color, i ride, and dissolved solids exceed standar parts of the basin. (USGS)
W84-00984

GROUND-WATER DATA FOR GEORG
Geological Survey, Doraville, GA. W sources Div.
S. E. Matthews, W. G. Hester, and K. W. McFadden.
USGS Open-File Report 82-902, 1982. Fig, 26 Ref.

Descriptors: *Groundwater, *Water Aquifers, *Georgia, Water quality, *Wa fluctuations, *Groundwater levels, Gro quality.

More than 2,000 water-level measureme in Georgia in 1981 provide the basic dat report. Daily mean water-level fluctua trends are shown in hydrographs for the year (1980) and fluctuations of the mont water levels are shown for selected years observation wells in Georgia. Water-qua ples are collected periodically throughout and analyzed as part of areal and regional water studies. Along the coast, chloride co tions have remained stable around Savan

f brackish water into the aquifer at has increased the chloride concentra- annual water levels throughout Geor- from 3.42 feet higher to 12.68 feet 81 than in 1980, and in some areas were on record. (USGS)

AL OF WATER FROM THE PELI- ER SAND-PLAIN AQUIFER, WEST- MINNESOTA,
Survey, St. Paul, MN. Water Re-
y bibliographic entry see Field 2F.

DE AND FREQUENCY OF FLOOD- SMALL URBAN WATERSHEDS IN PA BAY AREA, WEST-CENTRAL
Survey, Tallahassee, FL. Water Re-
y bibliographic entry see Field 2A.

OF WATER IN LOUISIANA, 1980,
Survey, Baton Rouge, LA. Water Re-
y bibliographic entry see Field 6D.

OLOGY OF THE HIGH PLAINS SYSTEM IN NEBRASKA,
Survey, Lincoln, NE. Water Resources
ohn, and H. H. Chen.
er Resources Investigations Open File 02, May 1983. 4 Sheet Maps, 16 Ref.

Great Plains, *Nebraska, *Ground- ifer, *Maps, Irrigation, Hydrogeologic ry period, Quaternary period, *High er system, Saturated thickness, *Water- irs, Depth to water, *Water-level de- r-level rises, Base of aquifer.

gic data used to evaluate the ground- tial of the High Plains aquifer system are presented on maps showing the d configuration of the base of the em, the potentiometric surface of the em prior to 1950 and in 1980, and the vater and saturated thickness of the em in 1980. The High Plains aquifer rlies 177,000 square miles in parts of including 64,770 square miles in Ne- nsists of the Ogallala Group and other Quaternary deposits that are saturated ically connected to the Ogallala. The aquifer system in Nebraska is under- y by the White River Formation and ted rock of Cretaceous age. Water rly through the system at gradients 5 feet per mile. Tabular data indicate rated thickness of the aquifer exceeds 6% of the aquifer area; this same area % of the 4.9 billion acre-feet of water in ter levels declined in 15% of the and rose in 4% from predevelopment to ground-water and/or surface-water for irrigation. (USGS)

AND STREAM-VELOCITY DATA SACRAMENTO RIVER NEAR LIFORNIA, MAY 1978 TO SEPTEM-
Survey, Sacramento, CA. Water Re-
n.
-File Report 83-135, April 1983. 80 p, 4 Ref.

Aqueduct, Canal, Sand, Sediment n, *Sediment distribution, Settling mbed, Streamflow, Vertical distribu- rnia, *Stream velocity data, Data col- ramento River.

Sediment and stream velocity data from the Sacramento River are required to determine the size requirements of a settling basin for the intake area of the proposed Peripheral Canal near Hood, California. Sediment and stream-velocity data were gathered from May 1978 to September 1981 over several magnitudes of streamflow at four cross sections near Hood. This report, prepared in cooperation with the California Department of Water Resources, contains data that show the vertical distribution and size of sediment, and the magnitude and direction of stream velocity measured at 25 points in each of the four cross sections on several occasions. (USGS)
W84-01003

PRINCIPAL AQUIFERS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. Franks, J. Cushman-Roisin, J. A. Miller, C. B. Bentley, and H. Klein.
USGS Water-Resources Investigations Open-File Report 82-255, 1982. 4 Sheet Maps, 15 Fig, 7 Tab, 160 Ref.

Descriptors: *Groundwater, *Aquifers, Geohydrology, Unconsolidated aquifers, Coastal aquifers, Water aquifers, Water supply, Groundwater availability, *Maps, *Florida.

Ground water, readily available throughout most of Florida, is the primary source of drinking water for about 90% of the State's population. The State has several ground-water reservoirs that yield large quantities of water to wells, and also has some of the world's largest springs. Virtually all of Florida is underlain by underground sources of drinking water capable of yielding at least small quantities of water to wells. The principal source of ground water is the Floridan aquifer, which supplies most of the water used in the State. The Biscayne aquifer of southeast Florida, although limited in areal extent compared to the Floridan aquifer, is also a major source of ground water. Other principal aquifers are the sand-and-gravel aquifer of the western panhandle, and smaller, surficial and intermediate depth aquifers located beneath much of coastal and southern Florida. (USGS)
W84-01004

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN FLORIDA, MAY 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. G. Healy.
USGS Map Series No 104, 1982. 1 Sheet Map, 3 Fig, 17 Ref.

Descriptors: *Groundwater, Confined aquifers, *Maps, *Florida, Floridan aquifer, *Potentiometric surface.

The contours depicting the potentiometric surface of the Floridan aquifer for May 1980 were prepared from water levels measured in 1,818 wells. Comparison of the May 1980 potentiometric surface with that of July 1961 shows that the potentiometric surface has not changed appreciably from 1961 to 1980 except in areas of heavy withdrawals. Declines of the potentiometric surface, as shown by a map and hydrographs, range from less than 10 feet throughout most of the State to more than 20 feet in the northwest panhandle (Okaloosa County) and in west-central peninsular Florid (Polk County). (USGS)
W84-01005

SELECTED FLOW CHARACTERISTICS OF FLORIDA STREAMS AND CANALS,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. W. Foose.
USGS Water-Resources Investigations Report 83-4107, 1983. 265 p, 19 Fig, 1 Tab, 4 Ref.

Descriptors: *Low-flow frequency, *Duration table, *Hydrograph, Surface water, *Florida.

Data and statistics on low-flow frequency for 254 stream-gaging stations on Florida streams and canals are presented. The selected stations have 10 or more years of continuous record. A site description, a 10-year hydrograph, and a table of flow duration are presented for each station. A computed monthly 7-day, 10-year low flow is presented for 142 stations with flow patterns not significantly altered by controls or affected by other influences. (USGS)
W84-01012

WATER RESOURCES OF THE SANTA FE RIVER BASIN, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-01013

FLOOD PROFILES IN THE CALAPOOYA CREEK BASIN, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
J. Friday.
Available from the OFSS, USGS, Lakewood CO 80225; Paper copy $4.50, Microfiche $3.50. USGS Open-File Report 82-439, 1982. 30 p, 7 Sheet maps, 16 Fig, 3 Tab, 4 Ref.

Descriptors: *Floods, *Flood profiles, *Floodway, Surcharge, Computer model, *Oregon, Douglas County, Umpqua River, Calapooya Creek basin.

Water-surface profiles were computed for a 19.4-mile reach of Calapooya Creek in Douglas County, Oregon. The data will enable the county to evaluate flood hazards in the floodprone areas in the reach. Profiles for floods having recurrence intervals of 2, 10, 50, 100, and 500 years are shown in graphic and tabular form. A floodway, allowing encroachment of the 100-year floods, was designed with a maximum 1.0-foot surcharge limitation. A profile for a flood that occurred in November 1961 is also presented. All data were derived from a digital computer model developed for the study. (USGS)
W84-01021

WATER RESOURCES OF MANATEE COUNTY FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-01026

WATER RESOURCES DATA, NORTH CAROLINA, WATER YEAR 1982,
Geological Survey, Raleigh, NC. Water Resources Div.
H. C. Gunter, C. L. Hill, and T. E. Dillard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243881, Price codes: A21 in paper copy, A01 in microfiche. USGS Water-Data Report NC-82-1, 1982. 481 p, 9 Fig, 1 Tab. Prepared in cooperation with the State of North Carolina and with other agencies.

Descriptors: *North Carolina, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water Resources data for the 1982 water year for North Carolina consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and ground-water levels. This report contains discharge records for 143 gaging stations and stage and contents for 25 lakes and reservoirs; water quality for 86 gaging stations and 3 miscellaneous sites; and water levels for 56 observation wells. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements in this report. (USGS)
W84-01028

SMALL-STREAM FLOOD INVESTIGATIONS IN MINNESOTA, OCTOBER 1958 TO SEPTEMBER 1980,
Geological Survey, St. Paul, MN. Water Resources Div
K. T. Gunard, and C. J. Smith.
USGS Open-File Report 82-433, May 1982. 221 p, 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Small watersheds, *Minnesota, *Peak discharge, *Floods, Streamflow, Gaging stations, Flow characteristics, Stage-discharge relations, Basin characteristics, Flood depth.

An investigation of flood flows from small drainage basins in Minnesota is being made to aid in the design of bridges, culverts and other highway drainage structures. Results of the investigation provide peak-flow data on streams generally with drainage areas less than 200 square miles, placing particular emphasis on those with drainage areas lees than 10 square miles. Basin parameters being investigated for their effect on floods are drainage area, length of main stream, slope of main channel, basin altitude, forest cover, and storage area. All of the 187 gaging stations included in the report are equipped with crest-stage gages. In addition, 4 stations are equipped to record stage and precipitation continuously. The relative magnitude of flood flows for different hydrologic regions is shown in graphs that relate maximum discharge to drainage area. Station records contain location, drainage area, records available, type of gage, on-site structure elevations, bankfull stage, and annual maximum stage and discharge data. These data, with annual peak data from continuous-record stations, form the basis for statewide flood-frequency studies. (USGS)
W84-01033

8

GENERALIZED CONFIGURATION OF THE TOP OF THE LIMESTONE UNIT OF THE LOWER PART OF THE SURFICIAL AQUIFER, DUVAL COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Speechler.
USGS Open-File Report 82-336, 1982. 1 Sheet map, 2 Fig, 1 Tab, 6 Ref.

9

Descriptors: Geology, *Stratigraphy, *Aquifers, Surficial aquifer, Duval County, *Florida.

The top of the limestone unit ranges from about 25 feet above sea level in western Duval County to about 75 feet below sea level locally in the eastern part of the county. The limestone, which is part of the surficial aquifer, is the principal source of water to shallow wells in the county. The unit generally consists of a soft, friable, cavernous, sandy limestone, which ranges from about 5 to 40 feet in thickness. Along the coast and in the southern part of the county, the limestone becomes discontinuous. (USGS)
W84-01037

10

ANNUAL SNOWMELT AND RAINFALL PEAK-FLOW DATA ON SELECTED FOOTHILLS REGION STREAMS, SOUTH PLATTE RIVER ARKANSAS RIVER, AND COLORADO RIVER BASINS, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. G. Elliott, R. D. Jarrett, and J. L. Ebling.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $11.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-426, 1982. 86 p, 7 Fig, 1 Tab, 25 Ref.

Descriptors: *Flood hydrology, *Peak discharge, *Snowmelt hydrograph, *Rainfall hydrograph, Foothills region, Mixed population, Data collection, *Colorado, *South Platte River basin, Arkansas River basin, Colorado River basin.

Peak flows in the foothills region of Colorado are attributable to two meteorological sources--snowmelt and rainfall. As part of a study of the hydrology of foothills streams in Colorado, charts from streamflow gages on unregulated streams were examined to determined the source of peak-flow events. Snowmelt-runoff peaks were distinguished from rainfall-runoff peaks on the basis of daily and seasonal occurrence, hydrograph shape, and local weather conditions. Peak-flow data for snowmelt runoff and rainfall runoff are presented for 69 streamflow-gaging stations in the South Platte River, the Arkansas River, and the Colorado River basins. (USGS)
W84-01038

IDENTIFICATION AND CLASSIFICATION OF PERENNIAL STREAMS OF ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
R. A. Hunrichs.
USGS Water-Resources Investigations Report 83-4063, 1983. 1 Sheet map, 7 Fig, 6 Ref.

Descriptors: *Perennial stream, *Low flow, Frequency analysis, *Arkansas, Recurrence intervals, *Classification.

Perennial streams are identified in a map and classified according to the relative magnitude of their 7-day, 10-year low flows. Perennial streams are identified for the entire State of Arkansas with the exception of the Mississippi Alluvial Plain. Also presented are the 7-day, 10-year low flow values at continuous-record and low-flow partial-record stations statewide. Perennial streams are defined in this report as having 7-day, 10-year low flows greater than zero. The perennial stream drainage was delineated using data from continuous-record and low-flow partial-record stations, and reconnaissance-site observations. The reconnaissance was conducted during the unusually dry summer of 1980. In analysis, the State was divided into hydrologic regions; they were used in conjunction with index stations to establish the recurrence intervals of flow observed, during the reconnaissance. When necessary, relations were developed by region to adjust observed flow to 10-year recurrence interval flows. (USGS)
W84-01041

HYDROLOGY OF AREA 49, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, MONTANA AND WYOMING,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2A.
W84-01043

WATER RESOURCES DATA FOR PUERTO RICO, 1981-82,
Geological Survey, San Juan, PR. Water Resources Div.
R. E. Curtis, P. W. McKinley, and H. M. Colon-Ramos.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-114701, Price codes: A18 in paper copy, A01 in microfiche. USGS Water-Data Report PR-81-82-1, (March 1983). 414 p, 25 Fig, 3 Tab.

Descriptors: *Puerto Rico, *Surface water, *Water quality, *Groundwater, Aquifers, Chemical analysis, Gaging stations, *Hydrologic data, Sediments, Streamflow, Water analysis, Water levels, Lakes, Sampling sites, *Data collection.

Water-resources data for surface-water, quality-of-water, and ground-water records for 1981-82 water years for Puerto Rico consist of records of discharge, water quality of streams, and water levels of wells. This report contains discharge and water-quality records for 40 gaging stations, 109 water-quality stations, stage records for 3 lakes, and water levels for 61 observation wells. Also included are data for 17 crest-stage partial-record stations. (USGS)
W84-01044

TRENDS IN GROUND-WATER LEVELS IN WISCONSIN THROUGH 1981,
Geological Survey, Madison, WI. Water Resources Div.
R. M. Erickson, and R. D. Cotter.
University of Wisconsin-Extension, Mad
logical and Natural History Survey, I
Circular No 43, 1983. 139 p, 15 Fig, 3

Descriptors: *Well hydrographs, *
fluctuations, Groundwater, *Groundwa
Well hydrographs, Observation wells, *

A summary of ground-water-level tren
consin through 1981 is displayed on hy
from more than 200 wells. These hy
display fluctuations in the potentiomet
of confined and unconfined aquifers.
are plotted from periodic (weekly or
measurements and from continuous-reco
records. Two hundred and ten hy
having periods of record of at least 5
tween 1934 and 1981 are included. Rec
wells date from the 1930's and 78 have
30 years of measurements. The water-lev
shown represent both natural fluctuatio
ing climatic control, and declines or
brought about by pumping or cessation
ing of ground water. Wisconsin's princip
are sand and gravel, sandstone, and dol
depth of wells utilized in the report rang
to 1,908 feet. (USGS)
W84-01047

**MEASUREMENT AND COMPUTAT
STREAMFLOW: VOLUME 2. COMPU
OF DISCHARGE,**
Geological Survey, Menlo Park, CA.
sources Div.
For primary bibliographic entry see Field
W84-01049

8. ENGINEERING WORKS

8A. Structures

ANNAPOLIS POINTS THE WAY FOR
J. C. Whitaker.
International Water Power and Dam Co
Vol 34, No 7, p 23-25, July, 1982. 1 F

Descriptors: *Tidal powerplants, *Tida
*Pilot plants, *Project planning, *Elect
production, Powerplants, Tidal hydrau
bines, Hydraulic turbines, Design criteri
electric power, *Nova Scotia.

As the tidal power project at Annapo
Nova Scotia nears completion, decision
made as to whether to continue plans for
larger Bay of Fundy tidal project. Should
program prove successful, significant savi
be realized if Straflo turbines are subst
conventional bulb turbines in the Bay
tidal power project. With this savings in
Federal Department of Energy, Mines,
sources added $25 million to the $46 mil
ed for testing the Straflo design. The p
will be linked to the provincial grid thr
km transmission line to the Lequille hy
substation. The Straflo unit is being mad
minion Bridge Company of Montreal a
Canada, a company out of Switzerland.
parameters of the Annapolis turbine and
struction progress are discussed. United
nancing of the Fundy project in exch
energy is expected to reduce the amou
consumed in the New York and New
areas. (Geiger-FRC)
W84-00972

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

**WATER-RESOURCES INVESTIGATIO
NORTH DAKOTA--FISCAL YEAR 1983,**
Geological Survey, Bismarck, ND. W
sources Div.
N. K. Lankford, and L. L. Albright.

pen-File Report 83-220, March 1983. 51 p,

ors: Water resources, Hydrology, vater, Surface water, Water quality, Hydata collections, *North Dakota.

ing water resources projects in North n fiscal year 1983, are listed. The report ared to inform interested federal, State, agencies and private individuals of the of the Water Resources Division in the ormation on each project includes objecproach, progress in 1982, plans for 1983, d and planned report products, and the he project chief. (USGS)
8

rants, Contracts, and earch Act Allotments

IES IN IDAHO, STATUS OF PROJSCAL YEARS 1982-83.
l Survey, Boise, ID. Water Resources

from the OFSS, USGS, Box 25, Denver, ; $6.00 in paper copy, $3.50 in microGS Open-File Report 83-40, December , 8 Fig, Channel, L.K., compiler.

rs: Hydrology, Hydraulics, Geology, cs, Geochemistry, Water resources, ater, Surface water, Quality of water, al resources, Monitoring, Model studies, transport, Sole-source aquifers, *Idaho, ive funding agreements, *Training, Edu-

ree projects were conducted by the ources Division of the U.S. Geological Idaho during FY's (fiscal year) 1982-83. jects were done in cooperation with e and local and nine federal agencies. local cooperative funding amounted to n FY 1982 and $570,000 (projected FY 1983; Federal funding amounted to in FY 1982 and $1,656,494 (projected FY 1983. Eighty-three persons were as of September, FY 1982--40 full time er than full time. Sixty-five persons were as of October, FY 1983--35 full time and han full time. In addition, the Water Division maintains a project office at National Engineering Laboratory. Work ne in cooperation with the U.S. Departnergy, which provides most of the fund- Federal funds are provided for special rojects other than continuing programs on of hydrologic data included floodtudies, geothermal-resource investigandwater-quality assessments, basin-and e water-resource investigations, river vater monitoring studies, volcanic-ashdies, groundwater trends and stream gram evaluations, river erosion and ansport studies, water-budget and er-use determinations, and a sole-source raisal. (USGS)

HISTORY OF THE U.S. GEOLOGIEY FEDERAL DATA COLLECTION LYSIS PROGRAM,
Survey, Reston, VA. Water Resources

de la Torre.
n-File Report 83-47, 1983. 14 p, 6 Fig, 8

: Adjudication, Compacts, Treaties, Stream Quality Accounting Network, ydrologic Benchmark Network fundologic data collection, *Federal pro-

gram activities in the collection and nydrologic data are funded in six catelished in order of priority. Over the to 1982, the funding available for the upported in each category has increased, but when viewed without the effect of inflation the purchasing power of the programs has generally decreased. Funding for adjudications, compacts, and treaties increased continuously from $588,600 in 1973 to $1,035,500 in 1981, and then decreased to $1,014,200 in 1982. However, when adjusted for inflation, based on a 1972 constant dollar, the constant dollars decreased from $555,800 in 1973 to $411,900 in 1982, which indicates that purchasing power was 26% less in 1982 than in 1973. Funding for the other five categories--the National Stream Quality Accounting Network, National Benchmark Network, Other Federal Agencies within the Department of the Interior, and General Federal Agencies Outside the Department of the Interior, and General Federal Hydrologic Interests--increased during the period, but the funding increase did not keep pace with inflation. During this 1973-82 period the U.S. Geological Survey has worked to make the Federal Data Collection and Analysis Program more cost effective by more efficient operational procedures and improved instrumentation, laboratory, and computation procedures. (USGS)
W84-00836

10. SCIENTIFIC AND TECHNICAL INFORMATION

10A. Acquisition And Processing

DEFINITIONS OF COMPONENTS OF THE MASTER WATER DATA INDEX MAINTAINED BY THE NATIONAL WATER DATA EXCHANGE,
Geological Survey, Reston, VA. Water Resources Div.
R. A. Perry, and O. O. Williams.
Available from the OFSS, USGS Lakewood, CO. 80225, Prices: $35.75 in paper copy, $4.00 in microfiche. USGS Open-File Report 82-327, 1982. 269 p, 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Information systems, *Information retrieval, Data processing, Documentation, *Indexes, Surface waters, Groundwater, Water quality, *National Water Data Exchange, Dictionaries, *Water data sites, System 2000, *Data base management systems, Data dissemination.

The Master Water Data Index is a computerized data base developed and maintained by the National Water Data Exchange (NAWDEX). The Index contains information about water-data collection sites. This information includes: the identification of new sites for which water data are available, the locations of these sites, the type of site, the data-collection organization, the types of data available, the major water-data parameters for which data are available, the frequency at which these parameters are measured, the period of time for which data are available, and the medial in which the data are stored. This document, commonly referred to as the MWDI data dictionary, contains a definition and description of each component of the Master Water Data Index data base. (USGS)
W84-00778

10C. Secondary Publication And Distribution

ANNOTATED REPORT AND DATA INVENTORY FOR THE MISSISSIPPI RIVER QUALITY-ASSESSMENT, MINNEAPOLIS-ST. PAUL METROPOLITAN AREA,
Geological Survey, St. Paul, MN. Water Resources Div.
T. A. Winterstein.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $13.00 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-869, September 1982, 104 p.

Descriptors: *Bibliographies, *Abstracts, *Mississippi River, Water quality, Basic-data collections, Dissolved oxygen, Water chemistry, Water pollution effects, Aquatic life, Freshwater fish, Mussels, Aquatic plants, Aquatic algae, Nutrients, Biochemical-oxygen demand, *River-quality-assessment project, *Minnesota River, St. Croix River, Minneapolis-St. Paul metropolitan area.

This inventory of reports and data concerning the Mississippi and Minnesota Rivers in the Twin Cities metropolitan area was compiled from November 1981 through January 1982 for a planned river-quality assessment to be conducted cooperatively by the U.S. Geological Survey and the Metropolitan Waste Control Commission. There are 260 annotated citations: 176 citations of reports; 8 citations of computer models that have been used to model either or both rivers; and 76 citations of data in reports, in field notes, lab sheets, or handwritten tabulations, and in computer data bases. Citations of all the reports and data located that might conceivably be useful in understanding and interpreting the biological and chemical quality of the Mississippi and Minnesota Rivers in the past, present, or future were included. The accuracy of the citations was not verified and secondary sources, such as other annotated bibliographies, were used in the compilation of this inventory. (USGS)
W84-00860

LITERATURE ASSESSMENT OF THE CHARLOTTE HARBOR ESTUARINE SYSTEM AND SURROUNDING AREA, SOUTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
Y. E. Stoker, and G. A. Karavitis.
USGS Open-File Report 83-127, 1983. 134 p, 1 Fig, 1289 Ref.

Descriptors: *Bibliographies, *Water quality, *Estuary, Freshwater inflow, *Marine resources, *Model studies, Fisheries, Groundwater, Surface water, Waste-load, Water use, *Charlotte Harbor, Peace River basin, Myakka River basin, Caloosahatchee River basin, Impacts, Biological assessment, Circulation, Radiochemicals, *Florida.

The Governor of Florida established the Charlotte Harbor Resource Planning and Management committee to recommend the course of action Florida should take in planning for potential growth in the rapidly growing area surrounding Charlotte Harbor. In May 1981, the U.S. Geological Survey began a planning study to determine detailed hydrologic study needs of the Charlotte Harbor area. A literature search of available data and reports pertaining to the Charlotte Harbor estuarine system and surrounding area resulted in almost 1,300 references. This report contains all references collected during this search. Some of the major reference topics are altered freshwater flow, water quality of the harbor and drainage systems, circulation and tides, coastal and marine resources, fisheries, geology and hydrology of the area, impact studies, water resources, flora and fauna of the area, and water supply. Sixty-eight key words or subject identifiers are used to the index report. (USGS)
W84-00992

10D. Specialized Information Center Services

DIRECTORY OF ASSISTANCE CENTERS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
B. M. Josefson, and C. D. Blackwell.
Available from the USGS, OFSS, Lakewood, CO 80225. Price: $4.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-925, 1982. 31 p, append.

Descriptors: *Assistance centers, Water data, Data assistance, *Information exchange, *Data storage and retrieval, Cooperatives, *Indexing, Assistance centers, Directory, *National Water Data Exchange(NAWDEX).

The National Water Data Exchange (NAWDEX), managed by the U.S. Geological Survey, has established a network of Assistance Centers throughout the United States and Puerto Rico to assist users of water data in identifying and locating the data they need. This Directory provides the information needed to contact any of the established Centers. (USGS)
W84-00814

DEFINITIONS OF COMPONENTS OF THE WATER DATA SOURCES DIRECTORY MAINTAINED BY THE NATIONAL WATER DATA EXCHANGE,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards.
Available from the OFSS, USGS Lakewood CO 80225, Price: $16.75 in paper copy, $4.50 in microfiche. USGS Open-File Report 82-923, 1982. 126 p, 3 Fig, 10 Ref.

Descriptors: *Information retrieval, *Data storage and retrieval, Organizations, Water sources, Publications documentation, Surface water, Groundwater, Water quality, *National Water Data Exchange(NAWDEX), Data definitions, SYSTEM 2000, *Data base management systems, Data dissemination.

This report contains a definition and description of each component of the Water Data Sources Directory data base maintained by the National Water Data Exchange (NAWDEX). It is intended, primarily, to assist those persons using the Water Data Sources Directory in understanding information obtained from the data base. The Water Data Sources Directory is a computerized data base maintained and operated using the System 2000 data base management system. It contains information about organizations that collect, store, and disseminate water data. (USGS)
W84-00815

DIRECTORY OF MEMBER ORGANIZATIONS OF THE NAITONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
C. D. Blackwell, and J. M. Nokes.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $9.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-902, 1982. 66 p.

Descriptors: Organizations, *Information exchange, *Information systems, *NAWDEX membership, *Directories, Information retrieval, Data collections, *Data storage and retrieval.

The National Water Data Exchange (NAWDEX) is a national confederation of water-oriented organizations working together to improve access to water data. It consists of member organizations from all sectors of the water-data community. This Directory provides the names, addresses, and telephone numbers of all NAWDEX member organizations and their designated NAWDEX representatives. (USGS)
W84-00816

INDENTIFICATION CODES FOR ORGANIZATIONS LISTED IN COMPUTERIZED DATA SYSTEMS OF THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards, and B. M. Josefson.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $15.25 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-921, 1982 (supersedes Open-File Report 81-904), 1982. 114 p, 1 Fig, 2 Ref.

Descriptors: *Data storage and retrieval, *Information and exchange, *Organizations, Indexing, Data transmission, *Organization identification code, Computerized data systems, *U.S. Geological Survey, National Water Data Exchange (NAWDEX).

This report contains codes for the identification of public and private organizations listed in computerized data systems. These codes are used by the U.S. Geological Survey's National Water Data Exchange (NAWDEX), National Water Data Storage and Retrieval System (WATSTORE), National Cartographic Information Center (NCIC), Office of Water Data Coordination (OWDC). The format structure of the codes is discussed and instructions are given for requesting new codes. (USGS)
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REVISED DESCRIPTION OF INDEX OF FLORIDA WATER DATA COLLECTION ACTIVE STATIONS AND A USER'S GUIDE FOR STATION OR SITE INFORMATION RETRIEVAL COMPUTER PROGRAM FINDEX H578,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. H. Geiger.
USGS Open-File Report 83-37, 1983. 76 p, 16 Fig, 3 Tab, 1 Ref.

Descriptors: *Computer program, *Hydrologic data, Data collection, *FINDEX, FNDXUP, FNDXST.

The report is an update of U.S. Geological Survey Open-File Report 77-703, which described a retrieval program for administrative index of active data-collection sites in Florida. Extensive changes to the Findex system have been made since 1977, making the previous report obsolete. A description of the data base and computer programs that are available in the Findex system are documented in this report. This system serves a vital need in the administration of the many and diverse water-data collection activities. District offices with extensive data-collection activities will benefit from the documentation of the system. Largely descriptive, the report tells how a file of computer card images has been established which contains entries for all sites in Florida at which there is currently a water-data collection activity. Entries include information such as identification number, station name, location, type of site, county, frequency of data collection, funding, and other pertinent details. The computer program FINDEX selectively retrieves entries and lists them in a format suitable for publication. The index is updated routinely. (USGS)
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 4
APRIL 1984

W84-01051 -- W84-01400

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SELECTED WATER RESOURCES ABSTRACTS

ATURE OF WATER

Aqueous Solutions and spensions

RPTION OF LEAD ON THE SUSPEND-RTICLES OF RIVER WATER,
ah Univ., Nablus (Israel). Dept. of Chemis-
m.
Research, Vol. 17, No. 4, p 423-429, April,
Fig, 2 Tab, 25 Ref.

ptors: *Lead, *Suspended solids, *Adsorp-rganic matter, Heavy metals, Particle size.

fects of the chemical composition and parti-e, of suspended particles in river water, on sorption of lead onto these particles have udied. Lead has been determined using the tional method of anodic stripping voltam-Particle sizes have been determined using ulter Counter. The organic matter content uspended particles has been found responsi-most of the lead adsorbed onto these parti-n attempt has been made to quantify the ship between the particle size of suspended s and the amount of lead adsorbed onto articles. The shape of the calibration graphs from solutions in river water has been ed with reference to the adsorption of lead ended particles. (Author's abstract)
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ATER CYCLE

General

TS OF BIOCLIMATE AND SOIL USE /ATER BUDGET TERMS IN WEST A (INFLUENCE DU BIOCLIMAT ET DE NAGEMENT DES SOLS SUR LES ELE-S DU BILAN HYDRIQUE EN AFRIQUE UEST),
le la Recherche Scientifique et Technique fer, Paris (France).
e, F. Lelong, and J. Colombani.
gical Sciences Journal, Vol. 28, No. 2, p June, 1983. 6 Fig, 9 Tab, 64 Ref.

tors: *Hydrologic budget, *Vegetation, tion, Runoff, Climate, Drainage, Soil type, er, Evapotranspiration, West Africa.

ative water budgets have been established urement (rainfall, runoff, soil moisture) and on (evapotranspiration, drainage) on six ental plots in West Africa throughout a tic sequence from the lower Ivory Coast al Upper Volta. These budgets show the ns of water budget terms with bioclimate, and pedological characteristics. In non-d plots (natural vegetation) the runoff low whatever the vegetation (1%-2% of ainfall). Deep drainage is near zero when ainfall is less than 900-1000 mm (equatorial d less than 700-800 mm (tropical areas). In d plots, runoff increases greatly but total noff + deep drainage) does not necessarily Thick soils, with important water storage increased evapotranspiration at the ex-drainage. (Author's abstract)
04

AND NITRATE-NITROGEN LOSSES A SMALL, UPLAND, COASTAL PLAIN SHED,
ural Research Service, Tifton, GA. South-ershed Research Center.
bbard, and J. M. Sheridan.
f Environmental Quality, Vol. 12, No. 2, 5, April-June, 1983. 4 Fig, 2 Tab, 13 Ref.

ors: *Surface runoff, *Storm seepage, *Ni-easonal variation, Mathematical studies, Water pollution sources, Prediction, atersheds, Coastal plain.

Surface runoff (SRO) and shallow-subsurface flow (SSF) from a small, upland, Coastal Plain watershed underlain by plinthite were monitored for a 10-yr period. Samples collected during surface runoff and subsurface-flow events were analyzed for NO3-N. The major water runoff loss from the system was found to be subsurface flow, accounting for 79% of total runoff loss, which occurred primarily from December through May. Nitrate-N concentrations in surface runoff and subsurface flow were relatively uniform over the period, averaging 0.47 and 8.75 mg/L, respectively. The combination of high volume of subsurface flow and its relatively high NO3-N content, resulted in 99% of total NO3-N loss via subsurface flow. Predictive equations for monthly surface and subsurface water runoff losses from this watershed were developed using multiple linear regression. The equations contain seasonal and climatic parameters, including pan evaporation. Tests of the equations with observed results gave significant ($P < \text{or} = 0.01$) correlation coefficients, r, of 0.82 and 0.85 for surface runoff and subsurface flow, respectively. Mean surface and subsurface NO3-N concentrations were multiplied by predicted monthly flows to compute predicted monthy NO3-N losses. Comparison of predicted and actual monthly NO3-N losses gave significant ($P < \text{or} = 0.01$) correlation coefficients, r, of 0.59 and 0.86 for surface and subsurface flows, respectively. The good fit of predicted and observed results can be partially attributed to the seasonal and climatic data base collected over a relatively long period of 10 yr. (Author's abstract)
W84-01188

HYDROLOGY OF THE JORDAN TRIBUTARIES (ISRAEL): HYDROGRAPHIC AND ISOTOPIC INVESTIGATION,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
B. Simpson, and I. Carmi.
Journal of Hydrology, Vol. 62, No. 1-4, p 235-242, April, 1983. 9 Fig, 1 Tab, 24 Ref.

Descriptors: *Geohydrology, *Isotope studies, *Groundwater movement, *Interflow, Tributaries, Jordan River, Oxygen isotopes, Tritium, Hydrograph analysis, Groundwater reservoirs, Rainfall, Springs, Catchment areas, Flow discharge.

Nahal Dan, Nahal Snir and Nahal Hermon are the three principal tributaries of the Jordan River. All three are spring-fed and appear to derive their discharges from the same regional groundwater aquifer. The behavior of this aquifer is examined by hydrograph separation and multivariate time-series analysis of discharge and rainfall records, and by investigation of O18 and tritium records. Hydrograph separation gives base-flow recession constants of 11-20 months and in addition Nahal Snir and Nahal Hermon show an interflow recession of about 1 month. The dual reservoir system for these two tributaries is confirmed by time-series analysis. O18 data distinguish the different catchments for the springs and support the idea that interflow occurs in the near-surface part of the regional groundwater reservoir. Tritium data illustrate the inhomogeneity of the karstic reservoir. Assuming well-mixed conditions, the difference in behavior between tritium records for rainfall and the tributaries is used to estimate the age distribution of water in the reservoir. At any time 50% of the storage is less than 1 yr old and 90% is less than 3 yr old. (Author's abstract)
W84-01223

DESIGN AND CONSTRUCTION OF THE THAMES BARRIER COFFERDAMS,
J. R. Grice, and E. A. Hepplewhite.
Proceedings of the Institution of Civil Engineers, Vol. 74, p 191-224, May, 1983. 1 Tab, 23 Fig, 4 Ref.

Descriptors: *Cofferdams, *Flood control, Thames Barrier, England, Design criteria, Construction, Excavation, Underwater, Piers, Abutments, River beds.

Heavy cofferdams were required to facilitate construction in the dry of the piers and abutments of the Thames Barrier at Woolwich (England) which is a flood defense barrier intended to protect London from flooding. The civil works were carried out in two main phases and different basic cofferdam designs were adopted for the two phases. In addition to the effects of differential soil and water levels on either side of the cofferdam walls, the design took into account surcharge of the river bed by sand-filled fairing cells located close to the cofferdam ends, and possible lateral loading transferred through the soil from adjacent fender structures. The design allowed for the excavation and the placing of the concrete base plug being carried out underwater, with unbalanced waterloads on the walls prior to dewatering being limited by the use of sluices through the sheet piles near low water level. To minimize interference with working space, no vertical bracing was provided. The larger cofferdams, 29 m deep, had four strutting frames in the phase 1 design, but only one in phase 2. Eleven deep cofferdams were constructed between 1974 and 1980 to enable nine piers and two abutments to be built across the river. (Moore-IVI)
W84-01250

WATER BUDGETS FOR SMALL DIKED MARSHES,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
J. A. Kadlec.
Water Resources Bulletin, Vol. 19, No. 2, p 223-229, April, 1983. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Marshes, *Hydrologic budget, Dikes, Cycling nutrients, Precipitation rate, Hydrologic cycle, Evapotranspiration, Seepage, Water storage, Hydraulic gradient, Permeability coefficient, Manitoba.

This paper reports an analysis of the water budgets of 10 small (5-6 ha) diked areas (cells) within the Delta Marsh in Southcentral Manitoba, Canada. The important terms in the water budget equation in this study were precipitation (P), water pumped in (SWI), evapotranspiration (ET), seepage in (GWI) and out (GWO), and change in storage (delta S). P, SWI and S were measured directly, and the sum of ET and GWO determined by difference. Estimating ET as 0.7 pan evaporation gave a seepage loss of 2.9 mm/day from the most intensively studied cell. Other methods of estimating ET produced estimates of GWO ranging from 2.4 to 3.8 mm/day. Water budgets for less intensively studied cells indicated seepage loss increased as perimeter available for seepage increased, but not proportionately. Efforts to measure seepage directly or estimate it from measured hydraulic gradients and hydraulic conductivity produced estimates much lower than the estimates from the water budget equation. Hydraulic conductivities were very heterogeneous, reflecting the sorting of water deposited sediments. Comparison of the hydraulic conductivities with seepage estimates from the water budget strongly suggests water movement downward as well as laterally from these diked areas. (Author's abstract)
W84-01283

EVALUATIONS OF WATER BALANCE MODELS ON A MIXED CONIFER WATERSHED,
Rocky Mountain Forest and Range Experiment Station, Flagstaff, AZ.
M. B. Baker, Jr., and J. J. Rogers.
Water Resources Research, Vol. 19, No. 2, p 486-492, April, 1983. 1 Fig, 9 Tab, 15 Ref.

Descriptors: *Hydrologic budget, *Mathematical models, *Evapotranspiration, *Streamflow, Forest watersheds, Runoff volume, Zero discharge, Snowmelt, Intermittent streams.

ARZMLT, BURP and ECOWAT, three water balance and yield models of differing degrees of complexity, were evaluated using data from a mixed conifer watershed in east-central Arizona. Statistical tests on simulated monthly flow volumes are provided with a comparison of 5-year mean annual estimates of evapotranspiration and streamflow. ARZMLT accounts for 87% of the variation

in monthly flow but produces the most bias in simulated monthly runoff volume. BURP accounts for 78% of the monthly streamflow variation and produces the least bias in monthly streamflow volume. The greatest problem with BURP is its inability to simulate zero flow events. Statistics for ECOWAT generally lie between those of the other two models. In an area where intermittent streamflow conditions exist and the majority of flow is from snowmelt, ECOWAT can be used without acquiring much additional error. Results from ARZMLT indicate that some structural changes in the model are needed to simulate the prevalent runoff conditions that exist in the southwest. (Moore-IVI)
W84-01349

EVALUATIONS OF WATER BALANCE MODELS ON A MIXED CONIFER WATERSHED,
Rocky Mountain Forest and Range Experiment Station, Flagstaff, AZ.
M. B. Baker, Jr., and J. J. Rogers.
Water Resources Research, Vol. 19, No. 2, p 486-492, April, 1983. 1 Fig, 9 Tab, 15 Ref.

Descriptors: *Hydrologic budget, *Mathematical models, *Evapotranspiration, *Streamflow, Forest watersheds, Runoff volume, Zero discharge, Snowmelt, Intermittent streams.

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W84-01350

MODELING THE EFFECTS OF A TIME-DEPENDENT WETTED PERIMETER ON INFILTRATION FROM EPHEMERAL CHANNELS,
Stanford Univ., CA. Dept. of Civil Engineering.
D. L. Freyberg.
Water Resources Research, Vol. 19, No. 2, p 559-566, April, 1983. 12 Fig, 12 Ref. ENG 76-01271.

Descriptors: *Infiltration, *Ephemeral streams, Channel geometry, Mathematical models, Soil water, Hydrographs, Wetted perimeter, Soil water flow, Vertical infiltration.

The effects of a time-dependent wetted perimeter on infiltration from ephemeral stream channel cross sections are explored using a conceptually simple mathematical model. The model is based on the assumptions of vertical soil moisture flow and the validity of the Green-Ampt model for vertical infiltration. By using a simple channel geometry, an analytic solution is found for the case in which the gravitational component of soil moisture flow may be neglected. An efficient, accurate numerical technique provides approximate solutions in the general case. Application of the model demonstrates that cross-sectional infiltration, that is, infiltration per unit length of channel, is a complex function of soil properties, channel geometry, and hydrograph shape. For the channel geometry considered, the direct effects of variable water pressure at the ground surface are overshadowed by the effects of variation in the wetted perimeter, with the result that the temporal variation in infiltration rate is quite unlike that which would be predicted assuming ponded infiltration alone. (Author's abstract)
W84-01357

COUPLED SURFACE WATER AND GROUNDWATER CATCHMENT MODEL,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
J. C. Miles, and K. R. Rushton.
Journal of Hydrology, Vol. 62, No. 1-4, p 159-177, April, 1983. 10 Fig, 1 Tab, 19 Ref.

Descriptors: *River basins, *Catchment areas, *Groundwater movement, *Surface flow, Hydrologic models, Mathematical models, Aquifers, Rainfall, Evapotranspiration, Geohydrology.

For river catchments in which there is significant interconnection between aquifers and the river, a thorough understanding of the way in which water is exchanged between the river and the underlying strata is important for resources planning. The formation of a model to represent surface and subsurface flows of water for a catchment in central England is described. A finite-difference model is used to represent groundwater flows in an aquifer with surface water flows being represented by flow balance techniques. Three hydrologically significant land types have been identified in the catchment: aquifer covered by permeable deposits; low-permeability strata covered by permeable deposits; and areas covered by impermeable drift. The model contains three components which correspond to these. The mode has been designed to be used as a tool for determining the long-term environmental effect of abstraction from the catchment. River flows are calculated for over 120 locations within the catchment. The results show that it is possible to formulate a comprehensive model, of a complete catchment, based upon measurable, physical parameters with the inflow of water being calculated solely from rainfall and evapotranspiration estimates. (Moore-IVI)
W84-01398

2B. Precipitation

DAILY PRECIPITATION OCCURRENCES MODELLING WITH MARKOV CHAIN OF SEASONAL ORDER,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou.
Hydrological Sciences Journal, Vol. 28, No. 2, p 221-232, June, 1983. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Precipitation, *Seasonal distribution, *Model studies, Markov process, Mathematical studies, Storm duration, Altitude.

The seasonality of the Markov chain order for properly modelling daily precipitation occurrences for precipitation stations in Greece is studied. The average seasonal storm duration, being the average seasonal ratio of the number of wet days to the number of storm events and influenced by the meteorology and geography of the station, is proposed as a criterion for determining the proper seasonal Markov order. For the records studied, and on a monthly basis, the latter, minimizing the chain's modelling error, is the closest positive integer to the average storm duration in days reduced by one. Orders greater than 1 are prevalent in wet periods, whereas in dry periods orders of 1 or 0 predominate. The appearance of the period with orders higher than 1 is delayed and its duration decreases towards the east and with decreasing altitude. The monthly sums of wet days are modelled better by a second order autoregressive model than by aggregating daily precipitation occurrences generated from a Markov chain. (Author's abstract)
W84-01099

APPLICATION OF NETWORK DESIGN PROCEDURES FOR REDESIGNING KIZILIRMAK RIVER BASIN RAINGAUGE NETWORK, TURKEY,
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.

For primary bibliographic entry see Field
W84-01100

WEATHER STATION SITING AN SUMPTIVE USE ESTIMATES,
Idaho Univ., Kimberly. Twin Falls Rese Extension Center.
R. G. Allen, C. E. Brockway, and J. L. W
Journal of Water Resources Planning and ment, Vol. 109, No. 2, p 134-146, April, Fig, 5 Tab, 13 Ref.

Descriptors: *Consumptive use, *Site *Weather stations, Irrigation, Evapotran Air temperature, Vapor pressure, Ari *Idaho.

The environment of a weather station site tant in estimating consumptive use by crops. Consumptive use may be over when air temperature and vapor pres from a weather station with an arid local ment are used without modification. To the effect of weather station aridity on tive use estimates, three sites in irrigated two sites in nonirrigated, and rangeland ern Idaho were instrumented with weathe during 1981. Air temperatures were hi vapor pressures were lower at the arid site air temperatures and dewpoint estimates sites caused an overestimation of evapot tion, by 17% (210 mm) over the irrigatio Results indicate the importance of wea evaluation and adjustment of siting eff weather before consumptive use estim made. A procedure is outlined for adjustin cal temperature data to reflect an irrigate tion. (Author's abstract)
W84-01144

USE OF HIGH HORIZONTAL RESO SATELLITE TEMPERATURE AND TURE PROFILES TO INITIALIZE A CALE NUMERICAL WEATHER PRED MODEL - A SEVERE WEATHER EVEN STUDY,
Australian Numerical Meteorology Centre, Melbourne.
For primary bibliographic entry see Field
W84-01168

TIME-EXTRAPOLATED RAINFALL MALS FOR CENTRAL EQUATORIAL ISLANDS,
National Weather Service, Washington, mate Analysis Center.
B. N. Meisner.
Journal of Climate and Applied Meteorolo 22, No. 3, p 440-446, April, 1983. 3 Fig, Ref.

Descriptors: *Rainfall distribution, *Prec *Pacific islands, Climatic zones, Ridge re Barometric pressure.

Normal annual rainfalls (means and med the period 1910-75 are estimated for islan central equatorial Pacific. Ridge regressi an empirically determined bias constant, i establish the relationships among the isla falls and those at Fanning, Nauru and B well as the mean sea level pressure at Dar estimated medians are less than those obse estimated means are greater than observe rainfall distributions have large positive s the median is more representative of cent ency, and the difference between the mean median is a measure of the variability. T sults imply that rainfalls in the central Paci smaller and more variable in the earlier pa century. Variations in the position and int the two major convective bands in the Pa Near Equatorial Convergence Zone and t Pacific Convergence Zone appear to acc most (88%) of the interannual rainfall va Although the interannual rainfall varia large, the secular variability is not. Mos adjustments were on the order of 10%, su that even short (20-30 year) data records

nably accurate estimates of normal rainfalls ese islands. (Author's abstract)
-01171

ONENTIAL SIZE DISTRIBUTIONS OF NDROPS AND VERTICAL AIR MOTIONS UCED FROM VERTICALLY POINTED PLER RADAR DATA USING A NEW THOD,
re de Recherches en Physique de l'Environne-, Issy-les-Moulineaux (France).
auser, and P. Amayenc.
nal of Climate and Applied Meteorology, Vol. lo. 3, p 407-418, March, 1983. 8 Fig, 3 Tab, 22

riptors: *Rain, *Radar, Rainfall, Weather, size.

drop-size distributions and vertical air motions deduced from vertically pointing C-band pler radar data by using a new method, the parameters method, which assumes the rain- sizes are exponentially distributed. Results ered in stratiform rain precipitation after the ge of a cold front are presented and compared those obtained by using the well-know rs approach. The new method, which does a priori require the knowledge of N sub 0 s is capable of detecting spatial and temporal tions much better than the Rogers method. ng this variability into account allows one to relationships involving three rainfall param- with good accuracy. (Moore-IVI)
-01172

NGES IN THE NATURE OF FLUCTU-ONS OF TEMPERATURE AND LIQUID TER CONTENT DURING THE LIFETIME A LARGE-SCALE STORM,
Force Geophysics Lab., Hanscom AFB, MA.
f. Dyer, and I. D. Cohen.
nal of Climate and Applied Meteorology, Vol. No. 3, p 385-393, March, 1983. 11 Fig, 3 Tab, ef.

criptors: *Storms, *Weather, *Cloud physics, tral analysis, Temperature, Liquid water con-

results of a spectral analysis of the horizontal tuations in temperature and liquid water con- measured by instrumented aircraft at four alti- s daily during four days in the life-cycle of a m moving eastward across the United States discussed, along with a synoptic analysis of the m. The storm itself was typical of the large e systems travelling across the continent during winter season. Each stage of the storm (devel-ent, maturity, and dissipation) exhibited dis-tive spectral characteristics. In addition, the dence that the age and previous history of the em greatly affect the fluctuation spectra is ng. The results of the study support the thesis characteristic spectral signature for cloud sys-s, as well as for single clouds. This method may sed to determine the present growth stage of a m system, and its potential for future develop-t. (Author's abstract)
4-01173

SOCIATIONS BETWEEN ANOMALIES OF MPERATURE AND PRECIPITATION IN E UNITED STATES AND WESTERN RTHERN HEMISPHERE 700 MB HEIGHT OFILES,
tional Climatic Center, Asheville, NC.
F. Diaz, and J. Namias.
rnal of Climate and Applied Meteorology, Vol. No. 3, p 352-363, March, 1983. 7 Fig, 3 Tab, 25 f. NOAA/NA81-AA-D-00054, NSF-ATM81-15.

scriptors: *Precipitation, *Climatology, *Sea-al distribution, Air temperature, Latitudinal dies, Temperate zone, Midtropospheric height, ather patterns.

e relationship between anomalous seasonal sur-e temperature and precipitation in the contigu-ous United States and concomitant fluctuations of western Northern Hemisphere 700 mb height as a function of latitude are examined. Findings are consistent with other studies dealing with the spatial patterns of midtropospheric teleconnections and their surface manifestations. A strong inverse relationship between temperature in the eastern United States and heights in the western Northern Hemisphere polar regions is present during winter and spring, especially in winter. In summer, the association is positive and is most evident in the southern tier of states. Fewer significant correlations are found between seasonal precipitation and midtropospheric height, with the strongest ones occurring in winter and summer. No correlation coefficient was statistically significant for the autumn season. Where significant, the regional precipitation variance of the other three seasons accounted for by the 700 mb height field varies from 11-44% in winter to 11-30% for spring and summer. Spatial coherence of the correlation pattern is appreciable but is not as strong as for temperature. In winter, during the period 1948-81, the frequency of below-average 700 mb heights has increased in the temperate latitudes of the western Northern Hemisphere. At the same time, a general increase in above normal polar latitude heights has taken place. This in turn has been associated with lower winter temperatures in the eastern United States. (Moore-IVI)
W84-01174

ON THE ANALYSIS OF EXTREME RAINFALLS,
Meteorological Service, Wellington (New Zealand).
K. J. A. Revfeim.
Journal of Hydrology, Vol. 62, No. 1-4, p 107-117, April, 1983. 2 Tab, 8 Ref.

Descriptors: *Rainfall, *Statistical models, *Recurrence time, Rainfall distribution, Return period, Temporal distribution, Rainfall extremes, Model studies, Mathematical models.

Two standard analyses of rainfall records are to obtain the expected maximum amount (depth) within a given time interval or expected recurrence time (return period) of a given rainfall amount. The methods in common practice assume little or nothing about an underlying time-dependent rainfall process. A simple recurrence model which represents the rainfall process in an intuitively realistic manner is developed in this paper. The statistical properties of the model provide small sample estimates of maximum amounts and recurrence times. Anomalies in rainfall analysis based on asymptotic theory do not occur in the recurrence model. (Author's abstract)
W84-01228

ERRORS IN THE THIESSEN TECHNIQUE FOR ESTIMATING AREAL RAIN AMOUNTS USING WEATHER RADAR DATA,
McGill Univ., Montreal (Quebec). Stormy Weather Research Group.
C. Damant, G. L. Austin, A. Bellon, and R. S. Broughton.
Journal of Hydrology, Vol. 62, No. 1-4, p 81-94, April, 1983. 4 Fig, 6 Tab, 21 Ref.

Descriptors: *Rain gages, *Radar, *Rainfall distribution, Thiessen polygon method, Weather data collections, Storms, Watersheds, Yamaska River watershed, Convective precipitation.

High-resolution radar data were used to estimate rainfall accumulation patterns for thirteen summer storms over the Yamaska River watershed. The results were compared with those obtained using the Thiessen polygon method. For any of the storms the error varied from $<8\%$ to $>100\%$ for each size subcatchment. The size of the error depended on the rainfall gradients produced by each storm and not greatly either on the area size or on the number of polygons associated with the area. The average error for all thirteen storms together over each subcatchment size varied between 15% and 84%, whereas the error over the entire watershed for each storm varied between 3% and 69%. The average error for all storms over the whole basin was 19%. It is concluded that for showery rain at least, the errors associated with using gage data are of significant magnitude and that users of streamflow models should be careful in the use of these data for convective showers. This paper also provides a review of some of the problems of estimating the spatial distribution of rain from both radar and raingage data. (McKeon-IVI)
W84-01230

SPATIAL-TEMPORAL MODEL OF STORM RAINFALL,
Leeds Univ. (England). Dept. of Statistics.
R. J. Marshall.
Journal of Hydrology, Vol. 62, No. 1-4, p 53-62, April, 1983. 5 Fig, 5 Ref.

Descriptors: *Rainstorms, *Statistical models, Rainfall distribution, Simulation analysis, Weather patterns, Model studies, Storms, Spatial distribution, Temporal distribution.

A multiple time series model is proposed to describe the spatial and temporal distribution of small-scale rainfall patterns. The model has seven parameters and is characterized by a multiple autoregressive scheme that has the property of its correlation structure being factorized into space-time components. Such a factorization explains the observed correlation structure of 2-min. rainfall of storms recorded by the Cardington and Winchcombe, England networks. The model can also be adapted to simulate within storm sequences or to generate moving storm sequences. (McKeon-IVI)
W84-01231

WEST AFRICAN WATER VAPOR VARIATIONS BETWEEN RECENT CONTRASTING SUBSAHARAN RAINY SEASONS,
Illinois State Water Survey, Champaign. Climatology and Meteorology Section.
P. J. Lamb.
Tellus, Vol. 35A, No. 3, p 198-212, May, 1983. 3 Fig, 5 Tab, 23 Ref.

Descriptors: *Water vapor, *Monsoons, West Africa, Seasonal variation, Drought, Rainfall, Rainy season.

Investigation is made of the interannual and intraseasonal variability of the southwest monsoon layer's thickness and moisture content over West Africa, and its water vapor supply to this region from the tropical Atlantic, for the Subsaharan (10 degrees - 20 degrees N) rainy season of July-September. Results for the very deficient 1968, 1971, and 1972 Subsaharan rainy seasons, whose departures from the 1941-74 mean ranged between -0.78 sigma and -1.39 sigma, are compared with those for the near-average rainy seaons of 1967, 1969, and 1975 (-0.27 sigma to +0.06 sigma). The observational base consists of monthly mean rawinsonde data from West African stations and seasonal estimates of the tropical Atlantic near surface specific humidity field. Subsaharan drought does not appear to be associated with the northward supply of unusually dry surface air to West Africa from the tropical Atlantic. Over West Africa, the magnitude of the vertically integrated monsoon layer advective water vapor flux tends to be proportional to the layer thickness. The extremely poor 1972 Subsaharan rain season (-1.39 sigma) coincided with particularly shallow southwesterly flow across the Gulf of Guinea coast (about 5 degrees N); thicker monsoon layers are found characteristic of the less severe 1968 (-0.78 sigma) and 1971 (-0.88 sigma) droughts. However, the monsoon layer depth here during the non-drought study years does not always exceed that for drought months. The direction of the low level water vapor flux above Dakar, a sensitive Subsaharan location (about 15 degrees N) on the West African coast, shows a stronger tendency to be from north of west during unproductive Subsaharan rainy season (-0.78 sigma to -1.39 sigma) than in near-average ones (-0.27 sigma to +0.06 sigma). This suggest the southwest monsoon does not extend as far north along the West African coast during Subsaharan droughts as in more abundant rainy seasons. In contrast to the foregoing Gulf of Guinea results, the monsoon layer over the interior

of the Subsaharan zone at about 13 degrees N exhibits minimal variability for the drought study years. The better developed nondrought southwesterly flows here tended to be thicker than those characteristic of most drought months. (Author's abstract)
W84-01311

SATELLITE OBSERVATIONS OF THE SOUTHERN HEMISPHERE MONSOON DURING WINTER MONEX,
Australian Numerical Meteorology Research Centre, Melbourne.
J. L. McBride.
Tellus, Vol. 35A, No. 3, p 189-197, May, 1983. 4 Fig, 1 Tab, 30 Ref.

Descriptors: *Monsoons, *Satellite technology, Infrared imagery, Convection, Tropical cyclones, Southern hemisphere.

Time-longitude strips of infrared GMS satellite imagery have been used to study the southern hemisphere summer monsoon during Winter MONEX (International Monsoon Experiment). This representation reveals a sudden monsoon onset in late December characterized by a transition to spatially organized convection. Active and break regions of the monsoon show a strong coherence in time but are very longitudinally dependent. The latitudinal dependence, on the other hand, is quite weak. The dominant spatial scale over which changes in convection take place is of order 35 degrees longitude by 15 degrees latitude. These synoptic scale convective regions can move in either the eastward or west direction. Typical phase speeds of movement range between 3 and 8 degrees longitude per day. Tropical cyclones in the region are revealed to be embedded in the large-scale monsoon circulation. (Author's abstract)
W84-01312

PATTERNS OF INDIA MONSOON RAINFALL ANOMALIES,
Wisconsin Univ.-Madison. Dept. of Meteorology.
S. Hastenrath, and A. Rosen.
Tellus, Vol. 35A, No. 4, p 324-331, August, 1983. 5 Fig, 1 Tab, 26 Ref. ATM76-09784, ATM79-11131.

Descriptors: *Rainfall distribution, *Monsoons, India, Tropical cyclones, Pattern stratification, Spatial distribution, Temporal distribution.

Pattern characteristics of annual rainfall anomalies over India during 1900-72 are studied from precipitation records of 31 regional subdivisions and series of annual cyclone frequency and number of break monsoon days. Methods include spatial correlation, pattern stratification, and principal component and spectral analyses. Pattern stratification with respect to an all-India rainfall index yields largest concordant departures in the Central and Western portions of the country. Pattern stratification with respect to the largest annual frequency of cyclonic storms in the Bay of Bengal and Arabian Sea show large positive rainfall departures over Eastern, Southeastern and Western India, and negative departures in the North and a limited area of the Southwest; for the collective of years with smallest storm frequency a partly inverse rainfall anomaly pattern is obtained. Pattern stratification with respect to the years of most numerous break monsoon days yields deficient rainfall in a large, broadly zonally oriented band across Central India, and positive departures in most other parts of the country. Stratification with respect to the least numerous break monsoon days yields a broadly inverse pattern. The first eight principal component patterns account for 74% of the total variance. The first component resembles the pattern obtained by stratification with respect to the all-India rainfall index, the two time series being highly positively correlated. The third component is approximately inverse to the pattern constructed from stratification with respect to the most numerous break monsoon days, the two time series being negatively correlated. The seventh component is similar to the pattern derived from stratification with respect to the largest frequency of cyclonic storms: this is consistent with the positive correlation between the two time series. No physical significance is apparent for the other principal components. The combination of the various analysis techniques thus serves to identify spatial and temporal pattern characteristics of possible physical significance. (Author's abstract)
W84-01313

A SIMPLIFIED SEMIEMPIRICAL APPROACH TO PROBABILITIES OF EXTREME HYDROLOGIC DROUGHTS,
Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven.
Water Resources Research, Vol. 19, No. 2, p 441-453, April, 1983. 13 Fig, 3 Tab, 33 Ref.

Descriptors: *Drought, *Streamflow, Probability distribution, Statistical models, Drought severity, Drought duration, Markov process.

On the basis of an available theory approximately valid for stationary first-order two-state Markovian processes and an assumption that the distribution of drought severity is approximately two-parameter gamma, a semiempirical method is proposed for the estimation of the probabilities of extreme drought durations and severities which may occur in the annual flow sequence of a stream during a period of finite length. The method is applied to the annual flows of eight streams in various parts of the world, and the semiempirical probability distributions obtained using this method are compared with experimental distributions obtained using synthetic streamflows generated with a lag one Markov model as well as a long-memory broken line model. The comparisons suggest that considerable insight into the extreme drought probabilities can be gained by the use of the simple semiempirical method introduced here. (Author's abstract)
W84-01344

AN INVESTIGATION OF THE CELLULAR STRUCTURE OF STORMS USING CORRELATION TECHNIQUES,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Shaw.
Journal of Hydrology, Vol. 62, No. 1-4, p 63-79, April, 1983. 7 Fig, 4 Tab, 19 Ref.

Descriptors: *Statistical methods, *Rainfall distribution, Rainstorms, Storms, Wind, Statistical analysis, Storm cells.

A statistical technique called 'full correlation analysis' has been applied to short-time interval rain data for 8 intense storms recorded at 2 raingauge networks set up by the British Meteorological Office. The technique has been used to investigate the cellular structure of the storms. Certain important storm parameters were estimated including the velocity and direction of movement of the surface rainfall pattern, its mean spatial scale and its lifetime. The results of the analysis suggested a typical cell size of the order of 3 x 1.5 km. The velocities and directions of movement of the surface rainfall patterns agreed well with the 700-mbar wind velocities recorded at the time of the storm. The average lifetime of the storm cells varied from 4 to 6 min. at one network to considerably longer periods at the second network. It appears that the technique of full correlation analysis is particularly suited for application to rain data of the type provided by long storms for which the corresponding meteorological observations were consistent with the existence of cumuliform convective cells embedded in the large-scale cloud mass and for which the centers of these storm cells pass over the recording network. (Moore-IVI)
W84-01367

2C. Snow, Ice, and Frost

ERUPTION-TRIGGERED AVALANCHE, FLOOD, AND LAHAR AT MOUNT ST. HELENS - EFFECTS OF WINTER SNOWPACK,
Cascades Volcano Observatory, Vancouver, WA.
R. B. Waitt, Jr., T. C. Pierson, N. S. MacLeod, R. J. Janda, and B. Voight.
Science, Vol. 221, No. 4618, p 1394-1397, 2
tember, 1983. 3 Fig, 12 Ref.

Descriptors: *Flood damage, *Volcanoes, *
melt, Snowpack, *Avalanches, Mass w
Mount St. Helens, Washington.

Hot eruption products from Mount St. Hel
19 March 1982 interacted with a thick sno
extending the impact of the eruption beyo
vent. A blast of hot pumice, dome rocks, a
dislodged crater wall snow that then aval
through the crater and down the north
Except in the crater, the only evidence t
avalanched snow melted during or just aft
placement was a freezing together of the
snow granules of the deposit. Apparently
internal friction and the warmth of the p
blocks caused incipient melting during th
lanche. A transient, crescent-shaped lake
oped between the dome and the crater wa
result of the melting of snow on the crate
and floor, and probably of snow that the ava
had piled behind the dome. The lake has
both east and west of the dome, but the
apparently melted faster than the water
escape from these two outlets. Abundant f
and entrainment of pumice and ash, and p
slushy snow, probably also decreased the f
of the water-pumice mixture so that hy
ponding was more effective than it would
been had the fluid been only water. A flo
water and pumice discharged simultan
through both outlets. The maximum flow fr
western outlet is delineated by a levee of
work pumice that emanates from the
pumice strandline and decends northward
rampart. Erosion and deposition by this flo
stroyed much of the surface morphology
1980 pyroclastic flow deposits. As long as
Helens remains active, a potential exists fo
snow avalanches, floods and lahars to be d
tive far from the vent. (Baker-IVI)
W84-01082

AN EARLY GLACIAL TWO-STEP,
R. A. Kerr.
Science, Vol. 221, No. 4606, p 143-144, July
1 Fig, 3 Ref.

Descriptors: *Glaciers, *Glaciohydrology,
ing, Ice cover, Glacial sediments, Glacier ba

Evidence from both the North Atlantic Ocea
the European continent support the pro
theory that deglaciation occurred in two-
From sediment samples it is suggested tha
peratures rose at least 6 degrees after 13,0
ago but fell to near glacial levels again duri
period 11,000 to 10,000 yr ago before warmi
good. Apparently cold polar waters retrea
the north and east only to push south again
as far as they ever did under glacial cond
The mid-transition cooling seems to be real, a
around the North Atlantic where the maj
sheets were clustered, but there is no agre
about why the transition did not go more sm
ly. An additional thought, that the disintegrat
the ice sheets could have accelerated ahead o
expected from increasing insolation, is still c
versial. Isotopic evidence does indicate that a
one-third of the ice had melted by 13,000 yr a
is suggested that ice sheet disintegration can
erate beyond that expected from direct h
because the initial meltwater would tend to c
the supply of moisture that feeds snow to th
sheets. This negative feedback would op
through several effects of the cold, freshwat
on the North Atlantic. Because the Atlanti
colder, less water would evaporate from the
and end up as snow on the ice sheets. Beca
was fresher, more of it would freeze in w
cutting off much moisture in the crucial w
months. The thin, stable surface layer would
less summer heat that could be used to evap
water in the winter. While this theory fits tog
well, there is still disagreement based on the t
of the first step of deglaciation: 13,000 to 11,0
16,000 to 13,000 yr ago. (Baker-IVI)
W84-01088

PENDED SEDIMENT PROFILE FOR ICE-ERED FLOWS,
rtment of the Environment, Burlington (On-). Hydrology Div.
primary bibliographic entry see Field 2J.
-01135

W COVER AND TEMPERATURE RELA-NSHIPS IN NORTH AMERICA AND EUR-A,
onal Aeronautics and Space Administration, nbelt, MD. Goddard Space Flight Center. ster, M. Owe, and A. Rango.
nal of Climate and Applied Meteorology, Vol. No. 3, p 460-469, March, 1983. 7 Fig, 3 Tab, 24

criptors: *Snow cover, *Air temperature, Cli-s, Seasonal variation, North America, Eurasia.

his study the snow cover extent during the mn months in both North America and Eura-as been related to the ensuing winter tempera- as measured at several locations near the er of each continent. The relationship between mn snow cover and the ensuing winter tem-tures was found to be much better for Eurasia for North America. For Eurasia the average v cover extent during the autumn explained as h as 52% of the variance in the winter (De-ber-February) temperatures compared to only for North America. However, when the aver-winter snow cover was correlated with the age winter temperature it was found that the ionship was better for North America than for sia. As much as 46% of the variance in the er temperature was explained by the winter v cover in North America compared to only in Eurasia. (Author's abstract)
-01170

CHANISM OF RUNOFF GENERATION OM AN ALPINE GLACIER DURING A ORM TRACED BY OXYGEN O18/O16,
e Univ., Amsterdam (Netherlands). Inst. of h Sciences.
primary bibliographic entry see Field 2E.
-01221

MPUTER MODELLING OF SNOWMELT OOD RUNOFF IN NORTH-EAST ENG-ND,
primary bibliographic entry see Field 2E.
-01251

NUMERICAL STUDY ON CYCLIC BEHAV-UR OF POLAR ICE SHEETS,
echt Rijksuniversiteit (Netherlands). Inst. voor eorologie en Oceanografie.
Derlemans.
lus, Vol. 35A, No. 2, p 81-87, March, 1983. 8 , 20 Ref.

criptors: *Ice sheets, *Mathematical models, ar regions, Ice flow, Ice accumulation, Tem-ature, Glacier surges, Bedrock, Melting, Heat nce, Relaxation oscillations.

sible cyclic behavior of polar ice sheets is stud-with a numerical ice-flow model. The model ludes a calculation of bedrock adjustment and perature field in the ice sheet. Basal water is ced and affects ice-mass discharge. Relaxation illations occur only for low ice-accumulation es (less than 5 cm ice depth per year). For larger accumulation rates, 2 steady-state regimes exist, pending on temperature: an ice sheet frozen to bottom, and an ice sheet subject to basal melt-everywhere. The volume of the latter is con-erably smaller (about 65% of that of the 'cold et'). In general, the mean basal ice temperature reases with increasing ice accumulation rate. is is due to the advection term in the heat ation (which has been ignored in earlier studies ice-sheet surging). (Author's abstract)
34-01310

ONE-DIMENSIONAL STOCHASTIC MODEL OF ICE MOTION IN WESTERN NORTON SOUND, ALASKA, U.S.A.,
Alaska Univ., Fairbanks. Geophysical Inst.
W. J. Stringer.
Arctic and Alpine Research, Vol. 15, No. 2, p 213-221, May, 1983. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Floating ice, *Ice drift, *Statistical models, Model studies, Sounds, Pack ice, Oil spills, Fate of pollutants, Ice budget, Alaska.

Analysis of short-term ice-floe displacement fields in western Norton Sound, Alaska, yields a statistical model for long-term ice-floe drift. The short-term ice motions are found to be normally distributed with an average velocity of 3.6 km/d westward, i.e., toward the entrance of the sound, and with a standard deviation of around 6 km/d. These short-term data are used to develop a one-dimensional stochastic model to describe long-term ice drifts along the axis of the sound. The statistically projected, long-term drifts are compared with observed long-term drifts and found compatible. These results indicate that although pack ice within Norton Sound is generally moving toward its entrance, a high degree of variability also exists such that even after a period as long as twenty days, a 70% probability remains of a net motion into the sound. These data are used to estimate the annual ice budget for Norton Sound and the fractional contribution of Norton Sound ice to the Bering Sea ice budget. In addition, the results are used to characterize the possible fate of a petroleum spill associated with pack ice in Western Norton Sound. (Author's abstract)
W84-01381

2D. Evaporation and Transpiration

A SOIL AND ATMOSPHERIC BOUNDARY LAYER MODEL FOR EVAPOTRANSPIRATION AND SOIL MOISTURE STUDIES,
Computer Sciences Corp., Silver Spring, MD.
For primary bibliographic entry see Field 2G.
W84-01339

2E. Streamflow and Runoff

ESTIMATING UNIT HYDROGRAPH PEAK RATE FACTORS,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, and T. R. Bondelid.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 238-250, June, 1983. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Hydrologic models, *Peak rate factor, Watersheds, Hydrographs, Runoff volume, Drainage area, Coastal areas, Mathematical models.

The Soil Conservation Service (SCS) dimensionless unit hydrograph model TR-20 is widely used for hydrologic design. The model uses a dimensionless unit hydrograph, with the drainage area, the depth of the runoff volume, the time-to-peak, and the SCS peak rate factor required to dimensionalize the unit hydrograph. A standard value of 484 for the peak rate factor is commonly used. While vague guidelines have been provided for modifying the value of the parameter, almost all designs are made using a value of 484. A method is presented that provides a systematic means of obtaining a value of the peak rate factor that is unique to a watershed. The method only requires a runoff curve number map, which should be developed to use the TR-20 model anyway. Application of the method to six watersheds, including three coastal basins, indicated that the method increases the accuracy of prediction; the peak rate factors computed using the procedure outlined compared very favorably with the values obtained by optimizing on measured rainfull hyetographs and runoff hydrographs. The results indicate that the value of 484 is too large for coastal watersheds on the Delmarva peninsula. (Author's abstract)
W84-01150

ON THE MATHEMATICS OF STORAGE ROUTING,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
C.-N. Chang, E. Da Motta Singer, and A. D. Koussis.
Journal of Hydrology, Vol. 61, No. 4, p 357-370, March, 1983. 3 Tab, 14 Ref.

Descriptors: *Routing, *Storage, Mathematical models, Simulation, Flood routing, Muskingum scheme, Hydrologic models, Storage routing.

Some mathematical aspects of storage routing are investigated analytically and through numerical simulation. The minimum size of the time interval required to eliminate computed values at the beginning of the outflow hydrograph falling below the initial steady flow rate is given for two routing schemes. The stability behavior of a refined Muskingum scheme is explored; it is found that values of the weighting coefficient up to 1.0 may be used with appropriately specified time intervals. The concept of 'relative' storage is analyzed and it is shown that it is unnecessary when the correct initial condition of the storage is considered. The classical best straight-line fit procedure between storage and weighted discharge is investigated. In an example case, it is demonstrated that this method of system identification is not reliable. The possibility of using discharge-dependent parameters is discussed. (Author's abstract)
W84-01217

MECHANISM OF RUNOFF GENERATION FROM AN ALPINE GLACIER DURING A STORM TRACED BY OXYGEN O18/O16,
Vrije Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
A. A. Van de Griend, and J. A. Arwert.
Journal of Hydrology, Vol. 62, No. 1-4, p 263-278, April, 1983. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Glaciers, *Storm runoff, Snowmelt, Rainfall-runoff relationships, Oxygen isotopes, Snow accumulation, Glaciohydrology, Glacial runoff, Isotope studies.

As a result of progressive fractionation and seasonal effects in snow accumulation on a glacier, O18/O16 ratios of glacier meltwater differ significantly from those of summer precipitation. O18/O16 ratios of precipitation and runoff have been used to separate pluvial and glacial runoff components from an alpine glacier during one single storm. It was found, especially during the rising limb of the hydrograph, that the bulk of runoff consisted of pre-storm meltwater, stored in the glacier body. On the basis of the results a better insight could be gained into the storage push-through process in the glacier body, active during the storm. This leads to a distinction between recharge and discharge zones on the glacier, the discharge zone being the main source area for quick response on rainfall. Thus, the mechanism of runoff generation of the alpine glacier studied is comparable with that found in normal headwater catchments. (Author's abstract)
W84-01221

CHEMICAL COMPOSITION OF RAINWATER AND FLOODWATERS IN THE NEGEV DESERT, ISRAEL,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
R. Nativ, A. Issar, and J. Rutledge.
Journal of Hydrology, Vol. 62, No. 1-4, p 201-223, April, 1983. 9 Fig, 6 Tab, 23 Ref.

Descriptors: *Floodwater, *Rainwater, *Water chemistry, *Salts, Deserts, Calcium, Magnesium, Sodium, Potassium, Carbonates, Chloride, Sulfates, Ions, Catchment areas, Lithology, Israel.

Rain and floodwater were sampled by self-sealing samplers scattered over the area of two drainage basins in the Negev Desert of Israel. The sampling was carried out during the winters of 1978-1981. Water was analyzed for the following ions: Ca(2+), Mg(2+), Na(+), K(+), HCO3(-), Cl(-) and SO4(2-). The chemical type of the rain and floodwater as well as the total quantities of salts

precipitated and drained out from the basins were investigated. The chemical characteristics of the rainwater falling in the Negev resemble those of rainwater in northern Israel, but the absolute quantities of ions are smaller. The total quantities of salts introduced into the basin were found to be larger than the quantities of salts drained out by the floods. The chemical composition of the floodwater was found to be governed by the lithology of the drainage basin and not by the initial chemical characteristics of the rain from which it was derived. (Author's abstract)
W84-01224

UNIT-STEP FUNCTION RESPONSE FOR SEVERAL HYDROLOGICAL CONCEPTUAL MODELS,
Academia Sinica, Beijing (China). Inst. of Geography.
G.-T. Wang, and K. Wu.
Journal of Hydrology, Vol. 62, No. 1-4, p 119-128, April, 1983. 4 Ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, Unit hydrographs, Laplace transform, Model studies.

To solve a rainfall runoff problem through the use of a conceptual model usually involves determining the instantaneous unit hydrograph (IUH) from rainfall and runoff records. In use it is necessary to convert the IUH into a unit hydrograph of finite duration D, DUH. For this the S-curve may be used. In this paper the rainfall data in 'blocks' of finite duration is represented by using the unit-step function. The output is obtained as the inverse Laplace transform of the product of the Laplace transform of the input so defined and the transfer function of the system. In this way output can be obtained corresponding to different conceptual models of the unit hydrograph. (Author's abstract)
W84-01227

ANNUAL FLOODS IN SOUTHWESTERN BRITISH COLUMBIA, CANADA,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
P. Waylen, and M.-K. Woo.
Journal of Hydrology, Vol. 62, No. 1-4, p 95-105, April, 1983. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Annual floods, *Gumbel distribution, *Snowmelt, *Rainfall, British Columbia, Seasonal distribution, Hydrology, Mathematical models.

In southwestern British Columbia there exists a transition from rain-generated floods in the west to snowmelt floods in the east. When a single process dominates, the Gumbel distribution provides an adequate fit to observed flood exceedance probabilities. The two processes produce distinct timing and magnitude characterizations in the resultant floods. The area of transition between these two sets of conditions displays varying mixtures of both characteristics which can best be fitted by a compounded Gumbel distribution. It is proposed that this technique is generally applicable wherever annual flood series are generated by more than one hydrological process. (Author's abstract)
W84-01229

COMPUTER MODELLING OF SNOWMELT FLOOD RUNOFF IN NORTH-EAST ENGLAND,
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Vol. 75, p 155-173, June, 1983. 5 Fig, 3 Tab, 29 Ref.

Descriptors: *Snowmelt, *Flood forecasting, *Runoff rates, Computer models, Simulation, Flood hydrographs, England.

Components of snow models, as related to British conditions, are discussed. A computer simulation model is described in which the snowmelt phase is linked with alternative systems of lumped or distributed catchment routing. The catchment phase of the model is calibrated using winter rainfall events on three upland catchments in north-east England. Then, with fixed catchment routing parameters for a particular catchment, snow phase parameters are optimized. Observed snowmelt runoff hydrographs are satisfactorily reproduced by model simulation, in most events. Results confirm that point melt and yield rates often exceed the current design rate for winter probable maximum flood estimation. The model provides a basis for operational snowmelt flood forecasting. (Author's abstract)
W84-01251

FLOOD FREQUENCY ANALYSIS FOR SMALL WATERSHEDS IN SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
S.-K. Chong, and S. M. Moore.
Water Resources Bulletin, Vol. 19, No. 2, p 277-282, April, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Flood frequency, *Gaging stations, *Small watersheds, *Illinois, Flood peak, Hydrologic data, Regression analysis.

Twenty-two gaging stations were selected for developing a regional flood frequency curve for small (area less than 2 square miles) watersheds in southern Illinois. Five probability functions were compared, and the extreme value type I function was selected to develop the regional flood curve. The curve was generated with the index flood method and also another empirical method that related the function parameters to the watershed area. Estimated peak discharges with various return periods were compared with the results obtained from multiple regression analysis. (Author's abstract)
W84-01276

SIMULATING SOIL WATER RECESSION COEFFICIENTS FOR AGRICULTURAL WATERSHEDS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
B. J. Choudhury, and B. J. Blanchard.
Water Resources Bulletin, Vol. 19, No. 2, p 241-247, April, 1983. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Agricultural watersheds, *Antecedent precipitation index, *Soil water, Agricultural runoff, Evapotranspiration, Remote sensing, Satellite technology, Mathematical models, Simulation, Recession.

The antecedent precipitation index (API) has been a useful indicator of soil moisture conditions for watershed runoff calculations, and recent attempts to correlate this index with spaceborne microwave observations have been fairly successful. The prognostic equation for soil moisture used in some of the atmospheric general circulation models (GCM) together with Thornthwaite-Mather parameterization of actual evapotranspiration leads to API equations. The recession coefficient for API is found to depend on climatic factors as contained in potential evapotranspiration and to depend on soil texture as reflected by field capacity and permanent wilting point. A recently developed model for global insolation is used with climatological data for Wisconsin to simulate the annual trend of the recession coefficient. Good quantitative agreement is shown with the observed trends at Fennimore and Colby watersheds in Wisconsin. This study suggests that API could be a unifying concept for watershed and atmospheric general circulation modeling. (Author's abstract)
W84-01280

STREAM FLOW IN RELATION TO OHIA FOREST DECLINE ON THE ISLAND OF HAWAII,
Forest Service, San Francisco, CA. Pacific Southwest Region.
R. D. Doty.
Water Resources Bulletin, Vol. 19, No. 2, p 217-221, April, 1983. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Stream discharge, *Soil-water-plant relationships, *Hawaii, *Forest hydrology, Forest watersheds, Precipitation, Rainfall-runoff relati
ships, Water quality, Ohia.

Dieback of the ohia forest over a large part of
Hilo watershed and adjacent areas has resulted
severe loss of the overstory crown component
the vegetation. The decline could cause seri
damage to the watershed. To evaluate poss
changes in conditions in the Hilo area since
decline began, stream flow, water quality,
precipitation data from 1929 to 1980 were coll
ed and analyzed. The limited data available do
indicate that the ohia decline has resulted i
significant change in either annual stream flow
peak stream flow of a stream discharging from
ohia forest in the Hilo area. Suspended sedim
production of two streams remains well wit
accepted levels as does the chemical makeup
components dissolved in the streams. (Autho
abstract)
W84-01284

**SALT TRANSPORT BY THE SOUTH PLAT
RIVER IN NORTHEAST COLORADO,**
Impolusa, Bilbao (Spain).
R. Gomez-Ferrer, D. W. Hendricks, and C. D.
Turner.
Water Resources Bulletin, Vol. 19, No. 2, p 1
190, April, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Salinity, *South Platte River, *Co
rado, *Stream discharge, Dissolved solids, Irri
tion effects, Supplemental irrigation, Draina
Leaching.

The salinity of the lower South Platte River
Colorado is characterized by plotting the avera
annual flow, total dissolved solids, and salt m
flow against distance along the stream. The pl
show that salts are being leached from the irrigat
lands above Greeley and are being deposited
the irrigated lands below Greeley. The salt depo
tion on the lower lands will result in their salin
tion. The plots show also that fall and wint
stream flows carry most of the salt loads. The
fall and winter flows are stored in off strea
reservoirs for use during the irrigation seaso
Therefore these salts are transferred to the low
irrigated lands where they accumulate. The s
balance for these lands can be improved by perm
ting the fall and winter flows to leave the basin,
by providing adequate land drainage coupled wi
supplemental irrigation water. (Author's abstrac
W84-01289

**TECHNIQUE TO RECONSTRUCT RIVER DI
CHARGE HISTORY FROM TREE-RINGS,**
Illinois State Water Survey, Champaign. Clim
tology and Meteorology Section.
W. M. Wendland, and D. Watson-Stegner.
Water Resources Bulletin, Vol. 19, No. 2, p 17
181, April, 1983. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Dendrochronology, *Stream di
charge, *Flood plains, Dating, Paleoclimatolog
Flood frequency, Precipitation, Mathematic
model.

Cores were obtained from several tree species l
cated both on a river floodplain and a nearb
terrace. A ratio of annual tree growth of floo
plains to terrace growth was developed and show
to be related to the annual river discharge. Growt
ratios from the time prior to written records ca
therefore be used to reconstruct river discharg
and infer past unrecorded flood frequency. Oa
and basswood ratios yielded the best models fo
discharge reconstruction, whereas those of elm an
birch were less useful. This method permits recon
struction of river discharge from an assemblage o
growth cores obtained within a relatively sma
area. (Author's abstract)
W84-01290

**APPROXIMATE SAMPLING DISTRIBUTION
OF THE SERIAL CORRELATION COEFFI
CIENT FOR SMALL SAMPLES,**
Geological Survey, Reston, VA.
G. D. Tasker.
Water Resources Research, Vol. 19, No. 2, p 579
582, April, 1983. 2 Fig, 1 Tab, 9 Ref.

ptors: *Correlation coefficient, *Stream- *Model studies, *Sampling, Mathematical , Correlation analysis, Distribution.

mpling distribution of the lag one serial tion coefficient is of some interest to hy- sts. It may be used as a likelihood function application of Bayes rules to obtain the or distribution of the population serial cor- n coefficient given a sample estimate. In an very large Monte Carlo study, a rather cated density function for an estimator of correlation was derived. This report pro- much less complicated approximate distri- of the sample serial correlation coefficient ious numbers of observations and shows it a very good approximation in the range of to hydrologists. (Baker-IVI)
1332

USE, FLOODS, AND CHANNEL GES: UPPER MIDDLE FORK WILLAM- RIVER, OREGON (1936-1980),
n State Univ., Corvallis. School of Forestry.
mary bibliographic entry see Field 4C.
1346

RESISTANCE IN GRAVEL BED MS AT BANKFULL STAGE,
nia Univ., Berkeley. Dept. of Geology and ysics.
Prestegaard.
Resources Research, Vol. 19, No. 2, p 472- pril, 1983. 5 Fig, 1 Tab, 16 Ref.

ptors: *Flow resistance, *Stream beds, el, Channel morphology, Grain roughness, ity, Keulegan equation.

low resistance in gravel bed streams with idth/depth ratios and low sinuosities is pri- a result of grain and bar roughness. The e importance of these two roughness ele- has not been established. The relative impor- f grain and bar resistance is examined for 12 t and divided gravel bed reaches at bankfull y using the Keulegan equation to determine ance division of energy slope. The remain- pe is assumed to represent the relative im- ce of bar resistance. Bar resistance accounts to 75% of the total resistance in these s. Calculated values of reach-averaged bar correlate closely with field measurements of gnitude. (Author's abstract)
1347

REMARKS ON THE TRUNCATION IN PARTIAL FLOOD SERIES MODELS,
Polytechnique, Montreal (Quebec).
kar, and J. Rousselle.
Resources Research, Vol. 19, No. 2, p 477- pril, 1983. 12 Ref.

ptors: *Flood flow, *Mathematical models, cal analysis, Stream discharge, Flood peak, magnitude, Flood frequency.

partial duration series approach to the prob- flood analysis, the truncation level above streamflow is regarded as flood flow plays a le. In the absence of a systematic and well d method for selecting such a level in prac- is desirable to know how different choices the obtained results. A mathematical investi- based on some commonly used partial flood models shows that once the time-dependent n process, used in modeling flood frequency d applicable with a certain truncation level, should remain so with any higher trunca- vel. This same property holds true for the ential distribution widely used in the study of magnitude. Guidelines such as those put for- by the Water Resources Council in relation tial flood series models should be followed aution and the effect of any restrictions put ch models by their underlying assumptions athematical characteristics should always be ed. If the Poisson and exponential distribu- are to be used then the choice of the base should be made primarily on mathematical grounds rather than on economic or engineering considerations. (Moore-IVI)
W84-01348

ESTIMATING A REGIONAL FLOOD FREQUENCY DISTRIBUTION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Water Resources Research, Vol. 19, No. 2, p 503-510, April, 1983. 5 Fig, 2 Tab, 34 Ref.

Descriptors: *Flood frequency, *Flood flow, Peak flow, Mathematical models, Statistical analysis.

When floods at different sites are assumed to arise from the same distribution except for scale (U.S. Geological Survey's Index Flood Method), one can attempt to identify the dimensionless flood-flow frequency distribution by normalizing small samples by each sample's sample mean. Unfortunately, the resultant curve may be a poor description of the true dimensionless flood distribution. This problem can be overcome by working with the logarithms of the peak flow values and using unbiased moment or probability weighted moment estimators. However, the correlation among concurrent flood flows in a region is shown to place severe limits on the accuracy with which a distribution's moments can be estimated with many such correlated records. (Author's abstract)
W84-01352

DESIGN EVENTS WITH SPECIFIED FLOOD RISK,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Water Resources Research, Vol. 19, No. 2, p 511-522, April, 1983. 4 Fig, 3 Tab, 76 Ref. CME8010889.

Descriptors: *Flood flow, Design floods, Statistical analysis, Probability, Flood plain management, Flood damage.

A maximum likelihood or method of moments estimate of the 99 percentile of a flood flow distribution is the traditional choice for the 100-year design flood event in flood plain planning. Because such estimates ignore the small-sample properties of quantile estimators, the resulting design event values will be exceeded with a probability in excess of that intended. For a sample size of 16 the estimated 100-year flood is, in expectation, the 50-year flood. Bayesian and classical statistical approaches can be used to develop design flood values which, given available hydrologic information, will (on average) be exceeded with the specific 1% design probability. Bias in estimates of expected flood damages and procedures for using regional information at gauged and ungauged sites are discussed. (Author's abstract)
W84-01353

2F. Groundwater

ANALYTICAL SOLUTION FOR TRANSIENT TWO-DIMENSIONAL UNCONFINED GROUNDWATER FLOW,
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
V. U. Nguyen, and A. J. Raudkivi.
Hydrological Sciences, Vol. 28, No. 2, p 209-219, June, 1983. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Differential equations, *Groundwater movement, Water table fluctuations, Laplace equation, Seepage, Flow rates, Mathematical studies.

An analytical solution of the differential equations describing the transient unconfined groundwater flow into a large cut such as an open strip mine is described. The free surface boundary of flow is time dependent and is not known beforehand. Discharge comes from the elastic storage and also from the lowering of the water table. The solution is based on a Laplace type formulation and provides, with the aid of the enclosed numerically evaluated functions, a quick and easy method of estimation of the phreatic surface and the flow rate as a function of time. Under certain conditions the solution approximates that based on the Dupuit approximation which neglects the vertical mass transport and puts the horizontal velocity proportional to the slope of the free surface. (Baker-IVI)
W84-01112

HP41C AND T159 PROGRAMS FOR ANISOTROPIC CONFINED AQUIFERS,
Kansas Univ., Lawrence.
A. D. Parr, J. G. Melville, and F. J. Molz.
Ground Water, Vol. 21, No. 2, p 212-220, March-April, 1983. 7 Fig, 4 Tab, 7 Ref.

Descriptors: *Permeability coefficient, *Confined aquifers, *Drawdown, *Computer programs, Pumping tests, Anisotropy, Mathematical studies.

Programs are presented for the HP41C and T159 programmable calculators for determining the ratio of horizontal to vertical hydraulic conductivity in anisotropic confined aquifers from pumping test data or for calculating drawdown given the aquifer parameters. The programs, based on Hantush's drawdown equations, eliminate the need to perform triple interpolation in obtaining the drawdown correction factor. By specifying a range of conductivity ratios, they can be used to solve the inverse problem given the drawdown data for a single observation well and the transmissivity and storage coefficient of the aquifer. The programs are illustrated by examples using the drawdown data from a pumping test performed in an anisotropic confined aquifer near Mobile, Alabama. (Moore-IVI)
W84-01115

GROUND-WATER MODELING WITH AN INTERACTIVE COMPUTER,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
G. L. Bloomsburg, and R. E. Rinker.
Ground Water, Vol. 21, No. 2, p 208-211, March-April, 1983. 3 Fig, 2 Ref. J0100013.

Descriptors: *Computer models, *Groundwater movement, *Mine drainage, Computer programs, Simulation, Saturated flow, Mine hydrology.

A large finite element program has been adapted to a PDP-11/23 minicomputer to obtain the advantages of an interactive computer system. The program used is UNSAT2, a code for unsteady, saturated and/or unsaturated flow of ground water. Some of the advantages of this interactive system are: ease of data input by the use of a digitizer; the opportunity to review all output files and to select for printing only those of interest; and the opportunity to change the physical boundaries of a problem at any desired time to make use of new information as a project progresses. This feature is particularly useful in mine-related water inflow predictions. This characteristic facilitates the simulation of flow into a vertical mine shaft as the shaft is being developed. To demonstrate the versatility of the program, it was used to simulate flow into a vertical mine shaft being developed in the Piceance Basin of Colorado. The major disadvantage is increased computational time. However, this disadvantage may not be particularly great because many organizations are not required to cost-account time on a minicomputer whereas this may not be the case for large machines. (Moore-IVI)
W84-01116

NOORDBERGUM EFFECT AND CHARACTERIZATION OF AQUITARDS AT THE RIO MAIOR MINING PROJECT,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. D. Rodrigues.
Ground Water, Vol. 21, No. 2, p 200-207, March-April, 1983. 8 Fig, 1 Tab, 11 Ref.

Descriptors: *Aquitards, *Sand aquifers, *Permeability coefficient, Pumping tests, Water level, Noordbergum effect, Drawdown, Portugal, Rio Maior Basin.

The planned exploitation of the Rio Maior lignite deposits will require a major dewatering program involving a thick leaky sand aquifer, and a heterogeneous and anisotropic aquitard complex. Diatomite, lignite, and clay are the main lithologies found in this aquitard complex. Characterization of the sand aquifer was accomplished by performing pumping tests with interpretations for steady-state and nonsteady-state conditions. Aquitards were characterized by using both laboratory and field tests to determine hydraulic conductivity. Field methods were either those commonly adapted to leaky aquifers using water-level data taken from observation wells tapping the underlying sand aquifer or those using water-level data taken from piezometers located at the same distance from the pumping well and screened in the aquitard and in the aquifer. Field values of hydraulic conductivity are greater than laboratory values. In several piezometers the Noordbergum effect was observed during pumping tests. Redistribution of the loads originated by the pumping in the underlying sand aquifer is considered to be responsible for the reverse water-level response in the overlying lignite-diatomite complex. The Noordbergum effect has some influence in the application of the ratio method. On a practical basis, it seems reasonable to use the Noordbergum effect to compute drawdowns in the aquitards, and this leads to somewhat higher values for vertical hydraulic conductivities. (Author's abstract)
W84-01117

HYDROGEOLOGY OF PIPELINE CANYON, NEAR GALLUP, NEW MEXICO,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
R. R. Raymondi, and R. C. Conrad.
Ground Water, Vol. 21, No. 2, p 188-198, March-April, 1983. 7 Fig, 5 Tab, 12 Ref.

Descriptors: *Geohydrology, *Alluvium, Infiltration, Mine drainage, Groundwater recharge, Groundwater movement, Groundwater pollution, Water quality, Sodium, Sulfates, Geologic fractures, New Mexico, Pipeline Canyon.

The principal water-bearing units (in descending stratigraphic order) in Pipeline Canyon are the alluvium, the Dilco Coal Member of the Crevasse Canyon Formation, the Torrivio Sandstone Member of the Gallup Formation, and the Upper and Lower Gallup Sandstones. Presently, the alluvium is recharged by a perennial, southward-flowing stream sustained by mine dewatering discharge in addition to natural precipitation and runoff. Localized infiltration has created ground-water mounds in the alluvium. Artesian conditions may exist in sandstone units which are adjacent and hydraulically connected to the alluvium in these areas. Basement faults have produced the Fort Wingate and Pipeline Canyon lineaments which intersect in the area of investigation. Fault-related fracturing of the sandstones allows for significant ground-water recharge via the overlying alluvium. Flow in the sedimentary formations is generally to the northeast, while the alluvial system flows to the southwest. The natural water quality for the aquifers in the area is dominated by sodium and sulfate ions. However, complete characterization of the natural water quality is complex because of ground-water contamination by acidic tailings fluids from a local uranium mill. (Author's abstract)
W84-01118

DETERMINING HYDRAULIC CONDUCTIVITY DISTRIBUTIONS IN A MOUNTAINOUS AREA USING MATHEMATICAL MODELING,
Campbell Geoscience Ltd., Calgary (Alberta).
G. R. Jamieson, and R. A. Freeze.
Ground Water, Vol. 21, No. 2, p 168-177, March-April, 1983. 10 Fig, 2 Tab, 4 Ref.

Descriptors: *Permeability coefficient, *Mathematical models, *Groundwater movement, Water table, Groundwater recharge, Geohydrology, Geothermal resources, Volcanoes, Hydrologic budget, Meager Mountain, Vancouver, British Columbia

Meager Mountain is a recently-active andesite-dacite volcano situated 160 km NNW of Vancouver, British Columbia. The mountain is presently being jointly evaluated by the Geological Survey of Canada and the British Columbia Hydro and Power Authority as a potential geothermal resource. Limited existing and field-generated geological and hydrogeological data were employed to evaluate the ground-water flow regime at the study area. Mathematical modeling was carried out to determine the feasible range of ground-water-flow characteristics in the area. Field observations indicate that the water table is located at an intermediate elevation in the mountain system with the discharge area confined to the portion of the valley covered by unconsolidated deposits. Water balance calculations for the Lillooet River basin and base-flow determinations in the Meager Creek basin indicated that 14 to 17% of the total precipitation recharges the ground-water system. Various possible geological configurations were mathematically modeled with the water-table configuration and recharge rates restricted to the above ranges. The model results were used to predict the variations in the hydraulic conductivity in each geological formation. The results fell into a discrete range of values thought to be within an order of magnitude of the actual values. (Author's abstract)
W84-01119

GROUNDWATER FLOW AND IMPLICATIONS FOR GROUNDWATER CONTAMINATION NORTH OF PREWITT, NEW MEXICO, U.S.A.,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens.
Journal of Hydrology, Vol. 61, No. 4, p. 391-408, March, 1983. 8 Fig, 2 Tab, 23 Ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *New Mexico, Geohydrology, Permeability coefficient, Groundwater recharge, Topography, Aquitards, Mathematical models, Path of pollutants.

In the southern San Juan Basin, New Mexico, strata of Permian and younger age dip gently toward the center of the basin. Most previous investigators believed that recharge to these strata occurred by precipitation on the outcrops and groundwater flowed downdip to the north and northeast. Recent water-level measurements in an undeveloped part of the basin near Prewitt, New Mexico, show that groundwater at shallow depths in alluvium and bedrock flows southward, opposite to the dip direction, and toward a major ephemeral drainage in a strike valley. North of this area, groundwater in deep bedrock aquifers does appear to flow northward. This information suggests that there are two groundwater circulation patterns; a shallow one controlled by topography and a deeper one controlled by geologic structure. Significant amounts of recharge to sandstone aquifers by infiltration through outcrops is unlikely due to the near-vertical exposures on cliffs, the gentle dip of the strata, and small annual precipitation. Numerical model results suggest that recharge to bedrock aquifers may be from downward leakage via aquitards over large areas and leakage from narrow alluvial aquifers in the subcrop area. The recharge mechanism is controlled by the hydraulic conductivity of the strata. As the flow path is controlled by hydraulic conductivity contrasts, geologic structure, and topography, contamination movement from surface impoundments is likely to be difficult to predict without a thorough hydrogeolical site investigation. (Author's abstract)
W84-01215

ASYMPTOTIC SOLUTIONS TO THE CONVECTION-DISPERSION EQUATION AND POWELL'S OPTIMIZATION METHOD FOR EVALUATING GROUNDWATER VELOCITY AND DISPERSION COEFFICIENTS FROM OBSERVED DATA OF SINGLE DILUTION TESTS,
National Research Inst. of Agricultural Engineering, Yatabe (Japan). Dept. of Water Management.
K. Fujinawa.
Journal of Hydrology, Vol. 62, No. 1-4, p 333-353, April, 1983. 6 Fig, 5 Tab, 20 Ref.

Descriptors: *Groundwater movement, *Co
tion, *Hydrodynamic dispersion, Mathem
studies, Dispersion, Solute transport, Tracers,
eholes.

Groundwater velocity and hydrodynamic di
sion coefficients can be determined simultane
from observed data of solute concentration a
center of a single borehole. Two types of as
totic analytical solutions to the convection-di
sion equation were proved to be applicab
analyze single borehole dilution tests. In ord
calculate the groundwater velocity, and the l
tudinal and transverse dispersion coefficien
three unknown variables in the asymptotic
tions, Powell's optimization method was appli
several cases together with the optimiz
method of Fletcher and Powell. The results o
application of these two optimization metho
several assumed sets and one actual experim
set of tracer concentrations showed that Pow
method based upon a conjugate direction p
dure without calculating derivatives is more
able, more flexible and much faster in conver
to the true values than the method of Flet
Powell, which is based on a conjugate gra
procedure utilizing both criterion functions
their first derivatives. Furthermore, when Pow
optimization method was applied together wit
proposed asymptotic solution to single bore
dilution data measured in field, the obtained v
of the groundwater velocity, and the longitu
dispersion coefficients were quite reasonable.
thor's abstract)
W84-01218

ORIGIN AND HISTORY OF NITRATE CONFINED GROUNDWATER IN THE W ERN KALAHARI,
National Physical Research Lab., Pretoria (S
Africa). Natural Isotopes Div.
T. H. Heaton, A. S. Talma, and J. C. Vogel.
Journal of Hydrology, Vol. 62, No. 1-4, p. 243-
April, 1983. 8 Fig, 2 Tab, 36 Ref.

Descriptors: *Confined groundwater, *Nitr
Groundwater recharge, Argon, Isotope stu
Climate, Dissolved gas, Confined aquifers, N
gen isotopes, Kalahari, History.

Data are presented for nitrate, dinitrogen
argon concentrations and N15/N14 ratios
groundwater, with radiocarbon ages up to 40
yr for three confined sandstone aquifers in
western Kalahari of South West Africa/Nam
The nitrate is probably generated within the so
the recharge areas, and its production rate du
the period 3000-40,000 B.P. has remained betw
0.5 and 1.6 meq NO3(-)1(-1) of recharge wa
with delta N15 between +4 and +8 0/00. V
ations in the amount of nitrate and of 'excess ai
groundwater recharge are found, and can c
reflect changes in the environmental conditi
during recharge. They must therefore be caused
the climatic changes that have taken place du
the past 25,000 yr. (Author's abstract)
W84-01222

MATHEMATICAL MODEL STUDY OF AQUIFER WITH SIGNIFICANT DEWATI ING,
Birmingham Univ. (England). Dept. of Civil E
neering.
K. R. Rushton, and D. C. H. Senarath.
Journal of Hydrology, Vol. 62, No. 1-4, p 143-1
April, 1983. 7 Fig, 13 Ref.

Descriptors: *Mathematical models, *Grou
water recession, *Confined aquifers, Groundwa
movement, Dewatering, Pumping, Simulati
Groundwater storage, England.

A finite-difference numerical technique is used
study the behavior of a Chalk aquifer in southe
England. Before abstraction commenced in
confined region the flow through the confined
small. Increasing abstraction from the confi
region has caused an increase in the groundwa
gradient and therefore in the flow from the unc
fined region; yet this inflow is only about 75%
the current abstraction rate. The additional wa

ided by localized dewatering around certain abstraction sites. A technique is devised for ing this local dewatering in a regional model. umerical model is used to understand the nechanisms within the aquifer with special sis on the balance between inflows from the fined region and water released from storage dewatering. The simulation covers a time of over 100 yr. (Moore-IVI)
01226

TOCHASTIC SYSTEMS MODEL OF NDWATER LEVEL FLUCTUATIONS,
a Univ. (Ontario). Dept. of Civil Engineer-

amowski, and T. Hamory.
l of Hydrology, Vol. 62, No. 1-4, p 129-141, 1983. 13 Fig, 3 Tab, 13 Ref.

iptors: *Mathematical models, *River flow, ndwater level, Analysis of variance, Water luctuations, Canada.

eries analysis techniques were used to devel- input-output model of a groundwater level . Groundwater level observations of the River Watershed were collected at Metcalf, o. A second-order model with five param- was found adequate. The unit-step response on suggested that a sudden rise in riverflow ty is followed by a very gradual increase in dwater level until after about 18 days when oundwater regime conditions are established. ain function damps out after an initial rise, ting that the low frequency components (i.e. months) dominate the system. Thus, ground- levels are more variable during high river than during low-flow conditions. The phase on reveals that in general, groundwater level ehind riverflow by about 0-1.6 months. The model accounts for 95.37% of the variance. eon-IVI)
01233

LYTICAL SOLUTIONS FOR RECTANGU- AQUIFERS WITH THIRD-KIND CHY) BOUNDARY CONDITIONS,
vare Univ., Newark. Dept. of Civil Engineer-

Corapcioglu, O. Borekci, and A. Haridas.
r Resources Research, Vol. 19, No. 2, p 523- April, 1983. 7 Fig, 1 Tab, 16 Ref.

iptors: *Aquifers, *Mathematical studies, wdown, Boundary conditions, Perched rs, Groundwater movement, Wells.

Fourier transformation techniques have applied to transient groundwater flow equa- for drawdown due to a single well pumping a rectangular aquifer with third-kind chy) boundary conditions. Inversion of the formed drawdowns yields solutions in the of infinite series as functions of spatial and oral variables. The solutions can be applied to ute the drawdowns either in a perched er or in an aquifer in contact with clogged beds. Numerical values are computed at the ons of interest to obtain three-dimensional sentation of drawdown. In the response of the ngular aquifer to a single well pumping at the r, the drawdown was shown to have the t value at the well in all cases, as expected. d form solutions obtained in this study could pecially useful for the problems in which the ods of images would not be directly applica- Analytical solutions can also sometimes be as partial checks of numerical solutions for -scale problems. (Baker-IVI)
-01331

OTE ON FRACTURE FLOW DISPERSION CHANISMS IN THE GROUND,
l Inst. of Tech., Stockholm (Sweden). Dept. hemical Engineering.
retnieks.
r Resources Research, Vol. 19, No. 2, p 364- April, 1983. 5 Fig, 2 Tab, 32 Ref.

Descriptors: *Geologic fractures, *Dispersion coefficient, Stratified flow, Diffusion, Sorption, Tracers, Channeling, Mathematical models.

Two mechanisms for spreading of a tracer pulse in fissured media are discussed: channeling and diffusion in the rock matrix. Dispersion has traditionally been treated as a random mechanism, comparable to diffusion. It is not quite clear if this is applicable to such geologic media as sparsely fissured rock or other stratified media. In this paper, two other mechanisms for dispersion are treated. One is stratified flow; the other is due to interaction with a solid material. A very idealized case of stratified flow is treated. A case is modeled where the medium flows in parallel channels. Each channel is assumed to consist of the space between two parallel plates. The flow is laminar. The various channel widths are assumed to be randomly distributed with a lognormal frequency distribution. This is a distribution which has been found experimentally in fissured crystalline rock. For this case, it is shown that an equivalent dispersion coefficient will increase with the distance between injection and observation point. For this case the normal Fickian diffusion dispersion description is not applicable if the usual assumption is made that the dispersion coefficient is constant. There are several interaction mechanisms of interest between a solute and the solid material. The one treated here is the diffusion of the solute into the porous rock matrix and sorption of the inner surfaces of the matrix. This interaction will also lead to the spreading of a tracer front, in a similar way to what other dispersion mechanisms do. It is demonstrated that if the solid material has very long extension, the dispersion due to this mechanism is so large that a Fickian dispersion coefficient cannot be evaluated without explicitly accounting for this mechanism. Attempts to evaluate Fickian dispersion coefficients by the method of moments will give values which are entirely dependent on the observation accuracy of the tail. (Author's abstract)
W84-01338

THEORY OF EARTH TIDE AND BAROMETRIC EFFECTS IN POROUS FORMATIONS WITH COMPRESSIBLE GRAINS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
G. van der Kamp, and J. E. Gale.
Water Resources Research, Vol. 19, No. 2, p 538-544, April, 1983. 1 Tab, 29 Ref.

Descriptors: *Pore pressure, *Earth tide, *Barometric effects, Groundwater movement, Geohydrology, Tides, Mathematical models, Stress, Strain.

The general three-dimensional equations for pore pressure, stress, and strain in a homogeneous porous medium with compressible grains are used to derive expressions for the response of fluid pressure to the stress changes due to earth tides and barometric loading effects. The analysis constitutes a generalization of earlier derivations. The formation is assumed to be of large extent laterally so that horizontal flow may be neglected. It is shown that vertical flow induced by the pore pressure changes can be analyzed by means of a diffusion equation. An expression for the specific storage coefficient is derived which is valid if horizontal deformations are negligible and which includes the effect of the compressibility of the solid grains. Measurements of earth tide and barometric effects constitute two in situ tests of bulk formation properties. Such measurements can therefore make an important contribution to the characterization of the hydraulic and elastic properties of a particular formation. (Author's abstract)
W84-01355

GROUNDWATER GEOCHEMISTRY AND CALCITE CEMENTATION OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. H. Chapelle.
Water Resources Research, Vol. 19, No. 2, p 545-558, April, 1983. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Groundwater, *Calcite, *Minerals, *Chemical composition, Aquia Aquifer, Maryland, Calcium, Manganese, Bicarbonate, Sodium, Aquifer characteristics, Cementation, Mathematical models.

The Aquia aquifer in southern Maryland exhibits three regions that are characterized by distinctly different water composition. Region I is about 42 km wide and is parallel to the outcrop area. Water in region I has relatively high calcium, magnesium, and bicarbonate concentrations and relatively low sodium concentrations. Region II, parallel to and downgradient from region I, is about 38 km wide. Water in region II is characterized by constant bicarbonate, increasing sodium, decreasing calcium, and decreasing magnesium concentrations. Region II is downgradient from region II and is characterized by low calcium, low magnesium, high bicarbonate, and high sodium concentration. The major lithologic constituents of the Aquia aquifer are quartz sand (about 55%), glauconite (about 30%), and carbonate shell material (about 8%). Heavy minerals, clay minerals, finely disseminated lignite make up about 2% of the aquifer material. Calcite cementation is commonly observed in and near the outcrop area of the Aquia. Stoichiometric chemical models were constructed based on this lithology to described the water chemistry of each region. The applicability of these models was verified by comparing predicted and observed molar ratios of dissolved species using linear regression techniques. In all cases, close matches were found between predicted and measured curves. Mass balance calculations using the verified chemical models predict a spatial distribution of calcite cementation that closely matches the observed distribution in the Aquia aquifer. This suggests that the observed calcite cementation is postdepositional in origin and has resulted from reaction of groundwater with aquifer material. (Author's abstract)
W84-01356

ANALYTICAL SOLUTION OF A PARTIALLY PENETRATING WELL IN A TWO-LAYER AQUIFER,
California Univ., Berkeley. Lawrence Berkeley Lab.
I. Javandel, and P. A. Witherspoon.
Water Resources Research, Vol. 19, No. 2, p 567-578, April, 1983. 7 Fig, 19 Ref. DE-AC03-76SF00098.

Descriptors: *Partially penetrating wells, *Layered aquifers, Pumping tests, Mathematical studies, Drawdown, Well yield.

The behavior of a two-layer aquifer pumped by a partially penetrating well is a matter of considerable interest. Analytical solutions are developed for drawdowns in either layer and are evaluated numerically to illustrate some typical cases. The validity of the solutions is demonstrated by comparison with the limiting single-layer case and with results from finite element calculations. Asymptotic solutions for small and large values of time are developed to show that (1) at early times with partial penetration the behavior of the pumped layer is exactly the same as that of a single layer and (2) at large values of time a semilog plot of drawdown versus time yields a straight line whose slope is only a function of the sum of the two transmissivities. A method is proposed for the interpretation of pump test data. (Author's abstract)
W84-01358

2G. Water In Soils

ISOTOPIC INVESTIGATION OF A NEAR-SURFACE GROUNDWATER SYSTEM,
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
S. K. Gupta.
Hydrological Sciences Journal, Vol. 28, No. 2, p 261-272, June, 1983. 4 Fig, 12 Ref.

Descriptors: *Tritium, *Deuterium, *Oxygen isotopes, *Groundwater dating, Precipitation, Radioisotopes, Mathematical models, Environmental tracers, Evapotranspiration, Aquifers, Aeration zone, *Isotope, Soil moisture, German Federal Republic, Rhine Valley.

The distribution of environmental tritium, deuterium and oxygen-18 in the unsaturated zone and the underlying sandy phreatic aquifer was studied throughout 1981 in an area of high pine forests in the Rhine valley near Heidelberg. The observed vertical distribution of isotopes in the unsaturated zone can be satisfactorily explained by the combined use of a multi-cell model for moisture transport and an evapotranspiration model. The distribution in the underlying aquifer of the tracer input at the water table obtained using this method is found by replacing the total vertical diffusion coefficient in the diffusion equation with the dispersion coefficient. In this way observed tritium profiles are satisfactorily simulated for the period 1966-1981. The stable isotope profile in the unsaturated zone however remains largely unexplained due to inadequate data on the stable isotope content of precipitation over the investigated area. (Author's abstract)
W84-01102

DROUGHT ANALYSIS AND SOIL MOISTURE PREDICTION,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 3F.
W84-01149

OPTIMUM MOISTURE CONTENT FOR COMPACTING SOILS: ONE-POINT METHOD,
Irrigation Research Inst., Lahore (Pakistan).
I. H. Hamdani.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 232-237, June, 1983. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Cohesive soils, *Soil compaction, Soil water, Soil density, Mathematical studies.

A one-point method for finding out Proctor Standard compacted maximum dry density and optimum moisture content of cohesive soils has been developed. It omits the usual laborious procedure of compaction test and requires only the determination of dry density of soil at 9% moisture content from which the maximum dry density and thereafter optimum moisture content can be found out. The method, therefore, shortens the time for the determination of the variables viz. maximum dry density and optimum moisture content for any given soil. On the basis of experimental data collected at the Irrigation Research Institute, Lahore (Pakistan), some mathematical relationships have been developed to compute the value of maximum dry density and optimum moisture content based on dry density of soil compacted at 9% moisture in a Proctor mold. (Author's abstract)
W84-01151

ASSESSMENT OF EVAPORATION FROM BARE SOIL BY INFRARED THERMOMETRY,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. Ben-Asher, A. D. Matthias, and A. W. Warrick.
Soil Science Society of America Journal, Vol. 47, No. 2, p 185-191, March-April, 1983. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Soil water, *Evaporation, Wind speed, Infrared thermometry, Energy, Infrared imagery, Remote sensing.

A method is described to estimate daily soil water evaporation from a drying uniform bare soil. The method involves wind speeds (u) and midday infrared thermometric measurements of surface temperatures of the drying soil (Td) and a nearby reference dry soil (To). Calculation of evaporation is made using a linear function of (To-Td) and u derived from basic energy balance considerations. An experiment was conducted in Tucson, Arizona, to compare lysimeter-measured values of evaporation with those estimated on the basis of the method. Three lysimeters (0.5 by 0.5 by 0.12 m) containing uniform soil were used in this experiment. One was kept wet (steady-state saturation), one was air dry, and one was initially wetted and allowed to dry during a 21-d interval in December 1981. Results showed a good agreement, $r(2)=0.61$, between the theoretical and measured values. The method is proposed for use in studies of field variability of soil water evaporation and is amenable to the utilization of remotely sensed data. (Author's abstract)
W84-01162

PHENOLOGICAL PATTERNS OF CHIHUAHUAN DESERT PLANTS IN RELATION TO THE TIMING OF WATER AVAILABILITY,
New Mexico State Univ., Las Cruces. Dept. of Biology.
P. R. Kemp.
Journal of Ecology, Vol. 71, No. 2, p 427-436, July, 1983. 2 Fig, 2 Tab, 40 Ref.

Descriptors: *Available water, *Desert plants, *Phenology, Timing, Species diversity, Photosynthesis, Seasonal variation, Soil water, Drought, Grasses, Forbs, Shrubs, Precipitation.

Phenology, density, and cover of plant species occurring in a single Chihuahuan desert habitat were studied for 2 yr as a function of habitat moisture with the objective of relating plant species diversity to water partitioning. Much of the temporal variation in growth and phenology between species was correlated with differences in life form and photosynthetic pathway. The annual plant species consisted of a winter-spring group containing only species with the C3 photosynthetic pathway which utilize the moisture from frontal storms of winter, and a summer group containing a large majority of species with the C4 photosynthetic pathway which utilize the moisture from convectional storms of late summer. The perennial plant species consisted of C3 and C4 forbs, C4 grasses, C3 shrubs and CAM shrubs. The C3 forbs showed greatest activity in spring or autumn while the C4 forbs and grasses were most active in the summer and autumn. The C3 shrubs and CAM shrubs were active at various times from spring to autumn and not as dependent as the other groups on available soil moisture. There was above average precipitation in late summer and autumn during the first year of study and an early and prolonged drought in autumn of the second year. Some species of perennial C3 forbs and C4 grasses responded to the abundant precipitation of the first autumn with increased density or cover in the second year, but there was little change in the shrub species. The drought in the second year caused a reduction in the number of species and individuals of both C3 and C4 annual plants. The results suggest that the high species diversity in this habitat is partly a result of the different life form and photosynthetic pathway groups, each being adapted for utilizing a particular phase of the seasonally and yearly variable water. (Author's abstract)
W84-01178

ELEMENTS RETURNED TO FOREST FLOOR IN TWO RAINFOREST AND THREE PLANTATION PLOTS IN TROPICAL AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Forest Research.
H. M. Brasell, and D. F. Sinclair.
Journal of Ecology, Vol. 71, No. 2, p 367-378, July, 1983. 2 Fig, 6 Tab, 40 Ref.

Descriptors: *Rainfall, *Cycling nutrients, Potassium, Calcium, Magnesium, Sodium, Litter, Rain forests, Forest soils.

Returns of potassium, calcium, magnesium and sodium to the forest floor in rainfall, throughfall, litterfall and branchfall were compared for tropical rainforest and adjacent plantations of Araucaria cunninghamii at two sites with contrasting rainfall and soil fertility. At one site a plantation of Flindersia brayleyana was also compared. At each site, the input of potassium was highest in the rainforest plots. The addition of sodium was higher at the wetter site, and was mostly derived from rainfall. Estimates of the loss of dry weight and elements from the litter layer, based on the relationship between litterfall and the standing crop of litter on the forest floor, were greater in the rainforest plots than in the Araucaria plantations. The annual [illegible] of litter disappearance (k, the quotient of annual litterfall to the mean amount of litter on forest floor) ranged from 0.69 for the Araucaria plot to 1.25 for the rainforest plot at the same [illegible] (Author's abstract)
W84-01179

BEHAVIOR OF CHROMIUM IN SOILS. INTERACTIONS BETWEEN OXIDATION-REDUCTION AND ORGANIC COMPLEXATION
Vermont Agricultural Experiment Station, Burlington.
B. R. James, and R. J. Bartlett.
Journal of Environmental Quality, Vol. 12, No. 2, 173-176, April-June, 1983. 5 Fig, 2 Tab, 7 R

Descriptors: *Tannery wastes, *Chromium, *Solubility, *Chelation, *Manganese, Toxicity, Oxidation.

Initial oxidation rates of different forms of Cr(III) added to an Aquic Udorthent soil, and the maximum Cr(VI) levels observed, decreased in the order: freshly-precipitated Cr(OH), is greater than Cr-citrate is greater than aged Cr(OH)3. The oxidation of Cr(III) in tannery sewage sludge and tannery effluent added to a Typic Eutrochrept soil also was studied as a function of time and loading rate. Amounts of Cr(VI) formed increased with Cr(III) added from 0.025 to 6.2 mmol per 100 g soil (29 to 7,200 kg per ha) for sewage sludge Cr(III), and from 0.1 to 1.8 mmol per 100 g soil (103 to 2,100 kg per ha) for the tannery effluent Cr(III). Levels of water-soluble Cr(VI) increased for a month in most of the treatments, despite the presence of reducing agents in the soil and in the wastes. Adding citric acid to the soil along with the tannery wastes increased the amount of Cr(VI) formed at each treatment level, and decreased the Cr(III) loading rate required for observation of oxidation. Mutual facilitation of Cr(III) oxidation by chelation and of further chelation by oxidation was postulated as a possible mechanism for the continuous formation of Cr(VI) in a soil. The reduction of soluble Cr(VI) in unlimed (pH 5.) and limed (pH 6.5) samples of an Ultic Hapludalf resulted in the formation of soluble organic complexes of Cr(III) if citric acid was added with the Cr(VI). During a 9-d incubation period, more reduction of Cr(VI) occurred in unlimed than limed samples, but higher levels of soluble Cr(III) chelate were measured in the limed treatment. Increasing the ratio of citrate to Cr(VI) increased the rate of reduction of the CR(VI) in the Aquic Udorthent. Soluble Cr(III)-chelate formed, and the length of time the Cr(III) remained soluble also increased with the citrate/Cr ratio. (Author's abstract)
W84-01202

VERTICAL INFILTRATION OF WATER INTO UNSATURATED SOILS WITH VARIABLE DIFFUSIVITY AND CONDUCTIVITY,
Thessaloniki Univ., Salonika (Greece). School of Technology.
P. K. Tolikas, D. K. Tolikas, and C. D. Tzimopoulos.
Journal of Hydrology, Vol. 62, No. 1-4, p 321-332, April, 1983. 2 Fig, 7 Ref.

Descriptors: *Soil water, *Infiltration, Diffusion coefficient, Permeability coefficient, Wetting front, Mathematical models.

A simple approximate analytical solution to the problem of vertical infiltration of water into unsaturated soils is presented. The soil-water diffusivity as well as the hydraulic conductivity are assumed to be exponential functions of the soil-water content. Constant-concentration conditions are assumed at the boundary. The infinite-domain problem is reduced to a finite-domain problem under the assumption of an abruptly terminating wetting front coinciding with the inflection point of the soil-water content profile. The location as well as the soil-water content at the inflection point are calculated and the result is employed for the approximate solution of the problem. Numerical results obtained by the theory of this paper are compared with those obtained by Philip's method.

is excellent agreement especially in the posi-
f the wetting front. (Moore-IVI)
01219

-WATER RESIDENCE TIME AND
TE UPTAKE; 2. DYE TRACING AND
ERENTIAL FLOW PREDICTIONS,
eld Univ. (England). Dept. of Geography.
Trudgill, A. M. Pickles, and K. R. J.
cm.
al of Hydrology, Vol. 62, No. 1-4, p 279-285,
1983. 4 Tab, 10 Ref.

riptors: *Soil water, *Preferential flow, Rain-
tensity, Soil saturation, Soil solution, Tracers.

occurrence of preferential flow, by-passing
eds, is predicted from the occurrence of
ll intensities in excess of pedal sorption; depth
eferential tracer penetration is estimated from
isplacement of this excess through a small
tional volume of preferential flow, theta sub f
eta sub f values are estimated from column
ge experiments to lie between 0.01 and 0.03
n/cu cm for rainfall intensities from 1 to 10
r, increasing to about 0.1 cu cm/cu cm at
tion. Observed tracer penetration is com-
with predicted tracer penetration and mean
e theta sub f values are calculated. The pref-
al flow calculations discussed provide a
approximation for characterizing field tracer
ior. (Author's abstract)
01220

FACE SOIL MOISTURE VARIATION ON
LL AGRICULTURAL WATERSHEDS,
nia Univ., Charlottesville. Dept. of Environ-
l Sciences.
Hawley, T. J. Jackson, and R. H. McCuen.
al of Hydrology, Vol 62, No. 1-4, p 179-200,
1983. 4 Fig, 4 Tab, 28 Ref.

riptors: *Soil water, *Agricultural water-
, Topography, Vegetation, Soil type, Crop-
Rangeland, Hydrologic models, Statistical
sis, Oklahoma.

ce soil moisture content is a state variable that
her simulated or required as input for many
logic models. In distributed hydrologic mod-
the watershed system is subdivided into spa-
lements that should be as homogeneous in
logic response as possible. In this study, the
tion of surface soil moisture was examined
se soil moisture is a major factor in determin-
ydrologic response. The influence of vari-
s in land cover, soil properties and topogra-
n surface soil moisture was investigated. Sta-
al analysis showed that topography was the
important factor controlling the distribution
il moisture within the small agricultural wa-
eds at Chickasha, Oklahoma. The presence of
tation tends to diminish the soil moisture vari-
s caused by topography, while the effects of
r variations in soil type were usually insignifi-
Comparison of variograms developed for
y flat cropland watersheds and more sloping
eland watersheds indicated that a much denser
ork of sampling points would be required to
lop soil moisture maps of a given accuracy on
angeland watersheds. For many modeling pur-
s, the subdivision of low-slope cropland water-
s into spatial units of homogeneous hydrologic
nse can be based on topography alone. (Au-
s abstract)
-01225

LUATION OF THE HYDRODYNAMIC
PERSION COEFFICIENT USING
CHED FRACTION EQUATIONS,
tral Soil Salinity Research Inst., Karnal (India).
. Pandey, and S. K. Gupta.
nal of Hydrology, Vol. 62, No. 1-4, p 313-319,
il, 1983. 2 Fig, 1 Tab, 9 Ref.

criptors: *Saline soils, *Hydrodynamic disper-
coefficient, *Leaching, Soil porosity, Hydro-
amics, Soil management.

movement of various chemicals in porous
ia with dispersion is of interest during reclama-
tion of saline soils. The hydrodynamic dispersion coefficient is one of the parameters used to predict the salt movement. A new approach is presented for determining the hydrodynamic dispersion coefficient, D. Equations were derived for predicting the leached fraction of salts for a particular salt-water system. Using these equations, relations for evaluating D for a step input and an initial state with uniformly distributed salts were derived and tested. The results indicate that predictions made using this approach are similar to earlier approaches. Also predictions of leached fractions of salts made using these parameters are in close proximity to observed values. (McKeon-IVI)
W84-01232

MODELING INFILTRATION INTO CRUSTED SOILS BY THE GREEN-AMPT APPROACH,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja.
Soil Science Society of America Journal, Vol. 47, No. 3, p 412-418, May-June, 1983. 4 Fig, 19 Ref.

Descriptors: *Soil surfaces, *Infiltration, *Soil crusts, Interfaces, Mathematical models, Soil water, Hydraulic resistance, Soil saturation, Unsaturated flow.

The study deals with infiltration of water through a stable surface crust, wherein the water content at the crust-soil interface increases with time for a long period, and remains below the saturated value. An approximate Green-Ampt-type formulation derived from a physical basis, containing a time-dependent capillary drive term and a profile shape factor, is evaluated by comparisons to a similarity solution and a finite-difference numerical solution of the problem. The exact nature of the derived Green-Ampt formulation is established for early to intermediate stages for certain reasonable conditions. Calculations of cumulative infiltration with time made by the above approach, with the profile shape factor set equal to unity, were within tolerable error from the numerical solution results for one soil and a set of experimental data for another. A previously reported piecewise application of the conventional form of the Green-Ampt equation is also developed to enable its use from time zero, as an independent predictive method. This method, which includes some implicit correction for the profile shape, gave slightly better calculations of the cumulative infiltration. The above simple methods should also be applicable to related unsaturated flow problems, such as infiltration through a transient crust-seal resistance and into a layered soil having a fine material overlying a course material. (Author's abstract)
W84-01254

EXPERIMENTAL VERIFICATION OF A MODEL TO PREDICT SOIL MOISTURE AND TEMPERATURE PROFILES,
R. J. Lascano, and C. H. M. van Bavel.
Soil Science Society of America Journal, Vol. 47, No. 3, p 441-448, May-June, 1983. 8 Fig, 6 Tab, 26 Ref.

Descriptors: *Soil water, *Soil temperature, Mathematical models, Simulation, Energy, Spatial variability, Soil layers.

A model was used to calculate water and temperature profiles over 30 d for a bare soil profile, using the hydraulic characteristics of the soil and standard meteorological data as input. The model was also used to determine the spatial variability of the calculated values, using the concept of similar media. The calculated profiles were compared to actual measurements, made periodically over the same period of time. The predicted water content values for different soil layers were within 1 standard deviation of the average measured values. The predicted temperature profiles were within 1 C of the measured values. The estimate of the spatial variability of the calculated values of water content was comparable to the variance of the measured values. Hence, it is concluded that the model was adequate to its purpose, under the conditions of the verification made. (Author's abstract)
W84-01255

INFLUENCE OF VELOCITY ON HYDRODYNAMIC DISPERSION DURING UNSTEADY SOIL WATER FLOW,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
W. J. Bond, and D. E. Smiles.
Soil Science Society of America Journal, Vol. 47, No. 3, p. 438-441, May-June, 1983. 2 Fig, 14 Ref.

Descriptors: *Hydrodynamics, *Unsteady flow, *Soil water, Mathematical studies, Velocity, Dispersion, Unsaturated flow, Solute transport, Constant flux absorption, Soil adsorption capacity.

A recent solution of the equation for hydrodynamic dispersion during unsaturated, unsteady soil water flow is extended to include the velocity dependence of the dispersion coefficient. The effect of this velocity dependence on the solute concentration profiles is illustrated for the case of horizontal constant concentration absorption of water by an initially dry soil. The application of the theory to other soil water flow situations, including constant flux absorption, is also examined. (Author's abstract)
W84-01256

LEACHING CHARACTERISTICS OF A STONY DESERT SOIL,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
D. Russo.
Soil Science Society of America Journal, Vol. 47, No. 3, p 431-438, 1983. 6 Fig, 2 Tab, 27 Ref.

Descriptors: *Leaching, *Desert soils, *Soil water, *Pressure potential head, Permeability coefficient, Infiltration rate, Conductivity, Soil solution, Dispersion, Stony soils.

The leaching characteristics of a stony desert soil were studied. The functional relationships between pressure potential head and gravimetric water content for the different soil layers were determined in the laboratory under drying conditions using samples in which the stony fractions (>2 mm) were excluded. These gravimetric water content values were converted to field volumetric water contents, using the field-measured values of the field bulk density and the stone fraction (on a mass basis). For a given pressure potential head, volumetric water content decreased with depth. Unsaturated soil hydraulic conductivity functions for the different soil depths were determined by the transient drainage profile method, using tensiometers and the appropriate soil water characteristics functions. The saturated hydraulic conductivities were estimated from the steady-state infiltration rate and the appropriate hydraulic head gradients. Measured saturated hydraulic conductivity values decrease with soil depth while for a given pressure potential head, the unsaturated hydraulic conductivity increases with depth. A leaching experiment was conducted in the field, by operating a sprinkler system at a rate of 7.6 mm/h. The time variations of the electrical conductivity (EC) of the soil solution as well as the concentrations of Na(+), Ca(2+), Mg(2+), Cl(-), and SO4(2-) were recorded by extracting soil solution samples from four soil suction probes located at a depth of 0.45 m and spaced 12 by 12 m apart. The initial average EC of 165 dS/m was reduced to 7.5 dS/m as 800 mm of water were applied to the soil. This final value of the EC of the soil solution is three times higher than the EC of the irrigation water, as a result of the presence of gypsum and relatively high ESP in the solid phase of the soil profile. Measured values of the EC of the soil solution were used to estimate the value of the dispersity for longitudinal dispersion, lambda. The resulting, lambda = 2.91 cm is in relatively good agreement with published field data of lambda for another soil, but is much smaller than the value of the equivalent field-scale dispersivity calculated for two different soils. (Author's abstract)
W84-01257

SIMPLE MEASUREMENTS OF SOIL SURFACE MICRORELIEF CHARACTERISTICS,

South Dakota State Univ., Brookings. Dept. of Plant Science.
E. M. White.
Water Resources Bulletin, Vol. 19, No. 2, p 231-233, April, 1983. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Soil surfaces, *Topography, *Surface runoff, Surface water storage, Roughness coefficient, Natural slope, Microrelief.

Soil surface roughness and the topographic orientation of microrelief influence runoff and water storage. Distances measured following the surface of the microrelief and horizontally across the area with the microrelief can be used with the number of microridges or microhills to estimate the average cross-sectional areas of the depressions, the microslope angles, and crest heights. Microridge sideslope angles which affect the rate of runoff were estimated reasonably well in field plots by the method. (Author's abstract)
W84-01282

AQUIC MOISTURE REGIMES IN SOILS WITH AND WITHOUT LOW CHROMA COLORS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
M. J. Vepraskas, and L. P. Wilding.
Soil Science Society of America Journal, Vol. 47, No. 2, p 280-285, 1983. 6 Fig, 4 Tab, 17 Ref.

Descriptors: *Soil water, *Soil saturation, *Water table fluctuations, Redox potential, Chroma colors, Perched water table, Iron compounds, Groundwater, Aquic moisture regimes, Soil organic matter.

Four seasonally saturated Alfisols along a toposequence 56 km north of Houston, Texas, were studied to determine if each soil had an aquic moisture regime. Water table fluctuations were monitored weekly during 1978 and 1979, and oxidation-reduction (redox) potentials and groundwater Fe contents were monitored weekly during 1979 only. Water tables of soils on backslope and toeslope positions were perched and rose to the surface during periods of heavy rainfall. Water tables of lowland soils were probably permanent, and their rise lagged behind those of the uplands soils by as much as 3 months. Redox potentials ranged from -200 to +900 mV across the toposequence during the year. Anaerobic conditions existed in each soil for variable periods. The periods when redox potentials (at a depth of 75 cm) were sufficiently low to reduce Fe(III) compounds generally increased from 6 to > 197 cumulative days from upper to lower topographic positions. Groundwater Fe contents were low, ranging between 0.1 and 2.7 ppm . Apparently little Fe reduction occurs in this landscape, because organic matter levels are low (< 1.0%). On the basis of the water table and redox potential measurements, each soil was considered to have significant periods of saturation and reduction with 75 cm of the surface. Low chroma (< 2) colors were not found in horizons (at a depth of 75 cm) which were reduced for 120 cumulative days, but color chromas were 3 or less along ped surfaces and ped interiors had mottles with chromas of 4 or more. Limitations of the low (< 2) chroma color criterion commonly used to identify aquic moisture regimes are discussed. Recommendations for use of color chromas of 3 or less for identification of aquic moisture regimes are proposed. (Author's abstract)
W84-01298

A SOIL AND ATMOSPHERIC BOUNDARY LAYER MODEL FOR EVAPOTRANSPIRATION AND SOIL MOISTURE STUDIES,
Computer Sciences Corp., Silver Spring, MD.
P. J. Camillo, R. J. Gurney, and T. J. Schmugge.
Water Resources Research, Vol. 19, No. 2, p 371-380, April, 1983. 9 Fig, 5 Tab, 18 Ref. NAS5-24350.

Descriptors: *Soil water, *Evapotranspiration, *Computer models, Remote sensing, Energy, Soil temperature, Thermal conductivity, Aerodynamic roughness, Air-soil interfaces.

A computer model of the upper soil and lower atmosphere boundary layer has been developed for use with remotely sensed data. It includes both energy and moisture balances, and it uses a predictor/corrector integrator with an automatically changing time step; these two components make the model both stable and efficient. It is driven by surface heat and moisture fluxes computed from standard meteorological data. Remotely sensed surface temperature and soil moisture can be compared to model estimates for calibration. The model has been tested using 44 hours of data from a bare soil site. Using daily maximum surface temperatures for calibration, estimated hourly surface temperatures agreed with measurements to better than 1 K. The results are insensitive to the soil heat capacity and most sensitive to the thermal conductivity and aerodynamic roughness. By varying these within physically reasonable limits, bounds on daily evaporation of 3.2 mm and 3.8 mm were estimated. (Author's abstract)
W84-01339

ESTIMATING PROFILE WATER STORAGE FROM SURFACE ZONE SOIL MOISTURE MEASUREMENTS UNDER BARE FIELD CONDITIONS,
Lockheed Engineering and Management Services Co., Inc., Houston, TX.
L. M. Arya, J. C. Richter, and J. F. Paris.
Water Resources Research, Vol. 19, No. 2, p 403-412, April, 1983. 8 Fig, 2 Tab, 25 Ref.

Descriptors: *Profile water storage, *Soil water, Mathematical models, Simulation, Soil surfaces, Irrigation, Corn, Surface flux, Remote sensing, Cultivation.

A linear regression approach was used to estimate profile water storage from the storage in the surface zone. For a given thickness of the surface zone the correlations between the surface zone and profile water storages decreased as the profile depth increased; for a given profile depth, these correlations increased as the surface zone thickness increased. In general, the correlations were higher for irrigated corn fields than for bare fields. Results show that the profile depth for which water storage can be predicted from surface zone soil moisture data depends on the thickness of the surface zone, the cultural condition of the field, and the coefficient of determination considered adequate. An alternative procedure to estimate water storage in a deep profile under bare field conditions is based on the assumption that change in profile water storage over a period of time equals net surface flux over the same time. Surface fluxes are computed from surface zone soil moisture data and hydrologic properties of the soil. In a simulation study, net surface fluxes very nearly equaled changes in water storage of a 2.25-m-deep profile. For a field-measured data set, computed surface fluxes and those measured by a weighing lysimeter showed good overall agreement. (Author's abstract)
W84-01341

UNSATURATED FLOW IN SPATIALLY VARIABLE FIELDS; 1. DERIVATION OF MODELS OF INFILTRATION AND REDISTRIBUTION,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan, and E. Bresler.
Water Resources Research, Vol. 19, No. 2, p 413-420, April, 1983. 3 Fig, 16 Ref.

Descriptors: *Soil water, *Infiltration, *Redistribution, Mathematical models, Unsaturated flow, Permeability coefficient, Soil water suction, Water flux, Vertical flow.

Models of water flow in the upper soil layer of spatially variable fields are developed. Field variability is assumed to take place in the horizontal plane. The saturated hydraulic conductivity is assumed to be a random variable of lognormal distribution, and head suction and moisture content are related to it by simple analytical relationships. The aim of study is to derive the expectation and variances of the moisture content, suction heads, hydraulic conductivity, and water flux as functions of depth and time for infiltration and redistribution. Toward this aim a simplified solution of verti flow in a homogeneous column, based on the co cept of moving front, is developed. The statisti procedure for using this solution in a spatia variable field is outlined. (Author's abstract)
W84-01342

UNSATURATED FLOW IN SPATIALLY VAR ABLE FIELDS; 2. APPLICATION OF WATE FLOW MODELS TO VARIOUS FIELDS,
Agricultural Research Organization, Bet-Dag (Israel). Volcani Center.
E. Bresler, and G. Dagan.
Water Resources Research, Vol. 19, No. 2, p 42 428, April, 1983. 5 Fig, 12 Ref.

Descriptors: *Soil water, Unsaturated flow, Mat ematical models, Infiltration, Redistribution, Pe meability coefficient, Wetting front, Hydraul properties.

The method of modeling water flow during infi tration and redistribution formulated in part 1 this study has been applied to compute expecta tions and variances of a few water flow variable and of effective hydraulic properties. Two spatia ly variable soils with different degrees of variatio have been investigated. The expectations and va iances are obtained by using the statistical averag ing procedure and probability density functio (pdf) of saturated hydraulic conductivity Ks. Th stationarity hypotheses and the requirement tha the integral scale of Ks is much smaller than th length scale characterizing the field in the x, plane have been adopted. An approximate solutio which assumes the concept of a wetting front an uniform water content is used for the statistica averaging procedure. A comparison of these re sults with data computed by a more accurate nu merical solution to Richard's equation shows tha the approximate simplified models lead to a quit accurate value of the expectations and variances o the flow variables when the field is sufficiently heterogeneous. It is suggested that in spatially vari able fields, stochastic modeling represents th actual flow phenomena more realistically and pro vides the main statistical moments (mean, var iances) by using simplified flow models which ca be used with confidence in applications. The field effective hydraulic properties have been defined and derived by using approximate models. It is shown that effective properties may be meaningful only under very restricted and special conditions, such as steady gravitational flow. They do not exist in the general case of infiltration-redistribution. It is concluded that the traditional deterministic approach for solving the flow equations cannot be justified for solving flow problems in spatially variable fields. (Author's abstract)
W84-01343

UNSATURATED FLOW IN SPATIALLY VARIABLE FIELDS; 3. SOLUTE TRANSPORT MODELS AND THEIR APPLICATION TO TWO FIELDS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
E. Bresler, and G. Dagan.
Water Resources Research, Vol. 19, No. 2, p 429-435, April, 1983. 4 Fig, 15 Ref.

Descriptors: *Solute transport, *Unsaturated flow, Soil water, Infiltration, Redistribution, Interstitial water, Wetting front, Salts, Mathematical models, Simulation.

An approximate model of salt transport in a spatially variable field during infiltration and redistribution is presented. The water flow is assumed to be vertical, and both pore water velocity and depth of wetting front change in the horizontal plane due to the variability of soil hydraulic properties. The salt transport in the vertical profile is computed by using an approximate, closed form solution of the convection-dispersion equation, with the value of the dispersivity increasing from zero to its maximum (3 cm) as the front propagates downward. The concentration profiles vary in the horizontal plane because of the aforementioned variation of water flow variables. The expectation value and the variance of the concentration are computed as

of depth and time for two variable soils
, with large variability, and Bet Dagan,
er variability). The results are compared
e based on a numerical simulation of the
w and salt transport, as well as with those
to an equivalent, deterministic, uniform
the expected value). The approximate
lds quite accurate results when compared
numerical simulations for the field of
riability, while some differences are
or the more uniform one. The results for
cted value, based on the traditional ap-
replacing the variable field by an equiva-
rm one, include a much larger error. In
the apparent complexity, the statistical
of salt concentration in a spatially vari-
can be determined by using simple flow
Therefore further refinement of models of
in homogeneous columns does not seem
ranted, and the research effort should be
ted on the study of field variability.
VI)
54

L SOIL VOLUME CHANGE EQUA-
THE TWO-PARAMETER MODEL,
ento Nacional de Plantas Oleaginosas,
(Spain),
ldez, G. Sposito, and C. Delgado.
ce Society of America Journal, Vol. 47,
19-422, May-June, 1983. 5 Fig, 3 Tab, 13

rs: *Soil water, *Soil volume,
tical models, Air entry, Soil physics,

lly based equation containing two adjust-
meters (the slope of the load line and the
water content) is proposed to describe the
f a swelling soil as a function of its water
This equation was shown to give an excel-
sentation of 18 sets of soil volume change
both laboratory and field measurements.
cases, a satisfactory description of volume
could be obtained by setting the slope of
ine equal to the specific volume of liquid
l adjusting only the value of the air-entry
ntent. The proposed equation should be
computer models of water movement in
oils. (Author's abstract)
99

lakes

NT LOADING ESTIMATES FOR

al Survey, Sacramento, CA.
ary bibliographic entry see Field 5B.
11

AL-RIVER RESPONSE TO NEOTEC-
DEFORMATION IN LOUISIANA AND
IPPI,
State Univ., Fort Collins. Dept. of Earth
s.
rnett, and S. A. Schumm.
Vol. 222, No. 4619, p 49-50, May, 1983. 5
ef. EAR-7727573.

rs: *Alluvial rivers, *Channel morphol-
tonics, Floodplains, Sinuosity, Gradient,
behavior, Geomorphology, Deformation,
, Slopes, Mississippi.

on on channel pattern (sinuosity), gradi-
, and channel behavior was collected for
rs crossing the Monroe uplift and three
ssing the Wiggins uplift. Repeat geodetic
demonstrate that both structures are
d the response of the alluvial rivers that
uplifts provides evidence of modern de-
. There are deformed Quaternary ter-
ich indicate long-term deformation in the
f the alluvial rivers that cross these struc-
l there are floodplain and channel convex-
provide evidence of modern deformation.
on, the channels show significant vari-
f morphology (sinuosity, gradient, and depth) and behavior appropriate to reaches of increased and decreased valley slope. These alluvial rivers are adjusting to modern deformation and their adjustment confirms two geodetic leveling anomalies. (Moore-IVI)
W84-01165

SILICON CONSUMPTION AND POPULATION DENSITY CHANGES OF DOMINANT PLANKTONIC DIATOMS IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
U. Sommer, and H.-H. Stabel.
Journal of Ecology, Vol. 71, p 119-130, March, 1983. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Silicon, *Diatoms, Lake Constance, Seasonal variation, Population density, Succession.

Interactions between silicon concentration and diatom growth have been studied in Lake Constance with data on number and volume of cells per unit volume of water and concentration of dissolved reactive silicon. Concentration of dissolved reactive silicon was found to decrease markedly during the spring and summer growth period of diatoms in 1979 and 1980. Amounts of silicon taken up per cell and per unit cell volume have been calculated from the changes in silicon concentration and the increases in population density for several diatom species. The silicon to cell quotient (mg per million cells) varied over a wide range from 0.005 for Stephanodiscus hantzschii to 0.72 for Synedra acus, while that of silicon per unit cell volume (mg/cu mm) varied over a narrower range from 0.10 for Stephanodiscus hantzschii and Fragilaria crotonesis to 0.36 for Synedra acus. A four-compartment model, that allows estimates of the rates of growth and of loss of diatom populations to be calculated, is outlined. Summer succession from Asterionella formosa to either Fragilaria crotonensis (in 1979) or Stephanodiscus binderanus (in 1980) is explained by interspecific differences in the effects of silicon concentration on growth and death. For Asterionella formosa, silicon depletion did not stop cell-division but led to the death of most of the population. For Fragilaria crotonensis and Stephanodiscus binderanus cell division stopped but cells did not die and population growth continued after the concentration of dissolved silicon had increased again. (Author's abstract)
W84-01181

EFFECTS OF ORGANIC MATTER ADDITIONS TO SEDIMENT ON THE GROWTH OF AQUATIC PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Barko, and R. M. Smart.
Journal of Ecology, Vol. 71, No. 1, p 161-175, March, 1983. 6 Fig, 6 Tab, 68 Ref.

Descriptors: *Aquatic plants, *Organic matter, *Sediments, Submerged plants, Emergent plants, Growth, Nutrients, Organic carbon, Decomposing organic matter.

Growth of three completely submerged species (Elodea canadensis, Hydrilla verticillata, and Myriophyllum spicatum) and three partly emergent species (Myriophyllum aquaticum, Potamogeton nodosus and Sagittaria latifolia) was examined on a control sediment and on the same sediment to which different types of plant organic matter (two labile and three refractory) had been added. With the addition of 5% organic matter, growth varied with the nature of the addition and the species of plant. Growth of emergent species was generally less inhibited than that of submerged species on sediment receiving this low level of addition. With greater additions of organic matter, growth of both H. verticillata and P. nodosus was severely inhibited irrespective of the nature of the addition. Labile organic matter (5% addition) inhibited growth of H. verticillata to a decreasing extent with time. In contrast, sediments receiving a 5% addition of refractory organic matter remained inhibitory to this species for at least 14 weeks. Growth was unrelated to concentration of Fe, Mn or PO4 in the interstitial water of sediments. However, low concentration of N in both interstitial water and plant shoots suggested possible N limitation of growth on sediment receiving refractory organic matter. Growth of H. verticillata on sediment with refractory organic matter added in a separate experiment was, however, unaffected by N addition to either the sediment, or water, or both. Growth of all species was negatively correlated with mean dissolved organic carbon (DOC) concentration in the interstitial water of the sediments. Growth inhibition may have resulted from the accumulation of toxic, soluble organic carbon compounds during anaerobic decomposition. The lesser inhibition of emergent plants compared with the submerged plants may have been due to the greater rhizosphere-oxidixing abilities of the former. The possible role of organic accretion in sediments was considered in relation to patterns of aquatic plant distribution and succession. (Author's abstract)
W84-01183

PHYTOPLANKTON PRODUCTION AND WINTER MIXING: CONTRASTING EFFECTS IN TWO OLIGOTROPHIC LAKES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
W. F. Vincent.
Journal of Ecology, Vol. 71, No. 1, p 1-20, March, 1983. 8 Fig, 9 Tab, 34 Ref.

Descriptors: *Mixing, *Phytoplankton, *Productivity, Seasonal variability, Thermal stratification, Light, Biomass, Photosynthesis, Nutrients, Limnology, Oligotrophic lakes, Storms, Nitrogen, Phosphorus, New Zealand.

Two deep oligotrophic lakes in the center of North Island, New Zealand, shared several limnological features but differed in their seasonal patterns of algal production. Lake Waikaremoana followed, in its thermal stratification, the classic pattern for temperate warm-monomictic lakes. During winter circulation, light availability to the phytoplankton was reduced by a factor of at least 13 relative to that in spring and summer, and there was no increase supply of phosphorus, which later controlled the amount of growth of its phytoplankton. Concentrations of algal biomass and algal production rates were predictably low, but rose rapidly with increased irradiance in spring. Lake Taupo experienced similar thermal stratification and mixing, but concentrations of algal biomass and algal photosynthetic production rose to maxima for the year during winter isothermy when temperatures were at their annual minimum and when mixing extended to the bottom of the lake. Winter circulation brought an increased supply of phosphorus and, more importantly, nitrogen which later controlled the amount of algal growth in the euphotic zone. This increased availability of potentially limiting nutrients offset the effects of low light availability and low temperature. Lake Taupo, and other nearby lakes which behave similarly, form intermediates between temperate lakes with typical winter minima of algal production and many tropical lakes which experience maximum phytoplankton production during storm-induced mixing. (Author's abstract)
W84-01185

ON THE ENVIRONMENTAL ISOTOPE METHOD FOR DETERMINING THE WATER BALANCE COMPONENTS OF SOME LAKES,
Institute of Physics and Nuclear Techniques, Krakow (Poland).
A. Zuber.
Journal of Hydrology, Vol. 61, No. 4, p 409-427, March, 1983. 6 Fig, 1 Tab, 23 Ref.

Descriptors: *Hydrologic budget, *Isotope studies, *Lakes, Isotopic tracers, Oxygen isotopes, Deuterium, Lake evaporation.

The paper deals with the isotope balance method applied to lakes, which can be assumed as being under steady-state conditions. It is shown that the long-term averages and non-normalized temperatures can be used in the balance equations. The applicability of the proposed approach was tested by the interpretation or reinterpretation of several

known case studies (Chala, Titicaca, Waid, Burdur, Beysehir and Egridir lakes). An isotope study of a small artificial lake (1,200,000 cu m) is presented and compared with whole-body tracing by K3(60)Co(CN)6. This artificial tracer does not appear useful for long-term tracing of surface waters. The water balance equation for each of the lakes considered was solved with the aid of the isotope balance equation of O18. Applying the calculated components of the water balance, the isotope balance equation of deuterium was solved for finding the values of kinetic enrichment for deuterium. These values, which give the fit of the evaporation lines to the experimental data, do not agree with the values known from direct laboratory experiments, thus they have to be treated as apparent values, which may be useful for future field work. (Author's abstract)
W84-01214

OBSERVATIONS OF TRANSPORT TO SURFACE WATERS FROM A PLUNGING INFLOW TO LAKE MEAD,
California Univ., Berkeley. Dept. of Civil Engineering.
H. B. Fischer, and R. D. Smith.
Limnology and Oceanography, Vol. 28, No. 2, p 258-272, 1983. 13 Fig, 6 Ref.

Descriptors: *Lake Mead, *Plunging inflow, *Mixing, Nutrients, Salinity, Wave action, Internal waves, Thermocline, Algal growth, Hydrodynamics, Seiches, Water temperature, Water circulation.

Algae growing in the surface water of Las Vegas Bay, an arm of Lake Mead, may receive nutrients contained in the stream entering through Las Vegas Wash. The stream water is more dense than the lake water due to dissolved salts. Existing hydrodynamic theory predicts that the stream should form a submerged layer isolating the nutrients from the surface. The theory was tested by introducing dye into the stream during two 14-day experiments; salinity, temperature, and dye concentration were monitored in the inner portion of the bay. Significant dye concentrations were found in the surface waters during both experiments, and two modes of internal waves with amplitudes up to 6 m were observed. The wave motion provided the main mechanism for transport to the surface in the first experiment; in the second an additional mechanism was the creation and destruction of temporary thermoclines due to meteorological variation. An approximate nutrient balance shows that in each case about 10% of the entering nutrients were available to the surface water within the 14-day period of the experiments. (Author's abstract)
W84-01244

TEMPERATURE, HEAT, AND MIXING IN LAKE VALENCIA, VENEZUELA,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, Jr.
Limnology and Oceanography, Vol. 28, No. 2, p 273-286, 1983. 5 Tab, 28 Ref. DEB7604300, DEB7805342, DEB8003883.

Descriptors: *Water temperature, *Mixing, Lake Valencia, Venezuela, Weather, Stratification, Water circulation, Heat budget, Eddy diffusion, Seasonal variation, Wind, Thermal stratification, Lake evaporation.

Water temperature profiles, weather data, and lake level data spanning a 2-yr period for Lake Valencia, Venezuela (10 degrees N, 67 degrees W), are used in an analysis of thermal regime, mixing, and heat flux. The lake, which has an area of 350 sq km and mean depth of 19 m, is warm monomictic; it becomes isothermal annually near the end of November, at the onset of the dry season. The water column during stratification consists of an upper mixed layer, which averages 13 m but varies greatly in thickness, followed by alternating thick layers of positive and negligible density gradients. The number of layers changes through time. Vertical eddy diffusivites during stratification vary from 0.23 cu cm/s at 20 m to 0.09 at 35 m. The mean annual heat budget is 5,308 cal/sq cm. Evaporative heat loss and net radiation flux are the two largest heat budget elements; net back radiation and sensible heat loss are important secondary terms. Seasonality, is principally traceable to heat budget terms influenced by minimum air temperature, whereas week-to-week variation is influenced by other terms as well. Maximum stability of the water column is about 350 g-cm/sq cm with little variation between yr. Work of the wind in distributing heat is 2,630 g-cm/sq cm for 1977 and 3,156 in 1978. Stability responds in a significant way to weather changes, even during stratification. (Author's abstract)
W84-01245

THE CHEMICAL COMPOSITION OF LAKES IN THE NORTH-CENTRAL UNITED STATES,
Minnesota Univ., Minneapolis. Dept. of Agriculture and Applied Economics.
E. Gorham, W. E. Dean, and J. E. Sanger.
Limnology and Oceanography, Vol. 28, No. 2, p 287-391, 1983. 11 Fig, 1 Tab, 43 Ref. GS23309, GB2448, GB6018, GB18800.

Descriptors: *Lakes, *Specific conductivity, *Ions, Water chemistry, Climates, Glacial drift, Limnology, Geology, Arid climates, Minerals.

Lake waters of the north-central U.S.A. are classified into five groups, based on increasing specific conductivity and changes in ionic composition from east to west, from Wisconsin through Minnesota to North and South Dakota. The most dilute group of waters has specific conductivities <29 micro mhos/cm at 25 C; the most concentrated group has specific conductances that range from 7,000 to 73,000 micro mhos. As conductivity increases all major ions increase, but there is a shift in cation dominance from Ca(2+) to Mg(2+) to Na(+), and in anion dominance from HCO3(-) to SO4(2-). This shift partly reflects a westward increase in climatic aridity, and partly a westward sequence of glacial drifts from noncalcareous to calcareous and thence to calcareous with abundant sulfur-bearing minerals. Levels of pH, K, Cl, F, B, and SiO2 also show a distinct westward increase. Concentrations of NO3(-) and Mn increase from east to west, but the trend is less distinct. Concentrations of Fe vary widely without any trend over the range of conductivity. Color, mostly from dissolved organic matter, is controlled chiefly by lake depth, except for lakes with extensive peatlands in their drainage basins. (Author's abstract)
W84-01246

SPRING BLOOM IN A HYPEREUTROPHIC LAKE, LAKE KASUMIGAURA, JAPAN-III; PHYTOPLANKTON ABUNDANCE IN STANDING STOCK OF ORGANIC MATTER IN LAKE WATER,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
H. Seki, and A. Masaki.
Water Research, Vol. 17, No. 4, p 453-457, April, 1983. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Eutrophication, *Phytoplankton, *Organic matter, Eutrophic lakes, Particulate matter, Bacterial, Detritus, Japan.

The rapid increase of phytoplankton biomass was the major process for the increase of particulate organic matter in Lake Kasumigaura in 1980. During the first phytoplankton pulse in the bloom relative abundance of each component of organic matter in the lake water was: dissolved organic matter 100, phytoplankton 28, bacteria 27, and detrital particle 27. This relative abundance was maintained as a steady-state oscillation throughout the spring bloom similar to that usually observed in moderately eutrophic waters. Thus phytoplankton abundance in the standing stock of organic matter of the hypereutrophic water during the spring bloom does not show any marked difference from that of moderately eutrophic waters. (Author's abstract)
W84-01268

SPRING BLOOM IN A HYPEREUTROPHIC LAKE, LAKE KASUMIGAURA, JAPAN-II;

SUCCESSION OF PHYTOPLANKTO CIES,
Tsukuba Univ., Ibaraki (Japan). Inst. of B Sciences.
Y. Hara, A. Tsuchida, and H. Seki.
Water Research, Vol. 17, No. 4, p 447-45 1983. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Eutrophication, *Phyto *Succession, Population dynamics, E lakes, Japan.

Numerous phytoplankton species in Lake gaura were shown to comprise the Spring 1980. The predominant phytoplankton spe appeared during the Spring bloom belong genera. A few species among them incr any time to form a phytoplankton pulse, few species of phytoplankters that com phytoplankton pulse did not exclude co other phytoplankters. During the Spring one pulse was replaced by another pulse co of a new grouping of different species. Thr these replacements by natural selection bloom were numerous other species by plankters at levels of abundance somew than those which formed phytoplankton (Author's abstract)
W84-01269

SPRING BLOOM IN A HYPEREUTR LAKE, LAKE KASUMIGAURA, JAPAN- CESSION OF PHYTOPLANKTERS WIT FERENT ACCESSORY PIGMENTS,
Tsukuba Univ., Ibaraki (Japan). Inst. of Bio Sciences.
H. Seki, and E. Takahashi.
Water Research, Vol. 17, No. 4, p 441-445, 1983. 7 Fig, 21 Ref.

Descriptors: *Eutrophication, *Pigments, * plankton, *Chlorophyll, Seasonal variation trophic lakes, Succession, Japan.

Phytoplankters appearing during the spring of 1980 in Lake Kasumigaura were classifie three groups characterized by different acc pigments. Phytoplankters of the first group phycocyanin, those of the second group chlorophyll b, and those of the third group chlorophyll c. Only eucaryotic phytoplankte longing to the second or third group, wer dominantly present during the bloom. Pre nance of the second and third groups alte during the bloom as individual phytopla pulses. The relationship between the popu density of all phytoplankters and the abunda phytoplankters possessing chlorophyll c co expressed as a highly significant regression (r=0.7997) throughout the spring bloom in chiura Harbor: Y=102.9e(-0.03138x) + where X is the concentration of chlorophyll a phytoplankters in lake water, and Y is the pe age of chlorophyll a possessed by phytopla possessing also chlorophyll c. (Author's abs W84-01270

DIATOM EVIDENCE FOR RECENT ACI CATION OF TWO SCOTTISH LOCHS,
University Coll., London (England).
R. J. Flower, and R. W. Battarbee.
Nature, Vol. 305, No. 8, p 130-133, Septe 1983. 2 Fig, 1 Tab, 28 Ref.

Descriptors: *Diatoms, *Acid lakes, *Dating, sediments, Scotland, Hydrogen ion concentra Catchment areas.

Claims that highly acid (pH <5.0), often fis lakes have become so as a result of recent (m twentieth century) acidification processes have been fully validated because there are few lakes that have been the subject of long-term tinuous monitoring. However, diatom analysi Pb-210 dated sediment cores can provide the tailed historical perspective required. These t niques are used to show that some lakes in the have become strongly acidified within the past yr. Analysis of cores from two lakes in Gallov south-west Scotland, indicate that both lakes, with an unafforested catchment and one wit

forested catchment, have experienced s of approximately 1 pH unit (from .5 to 4.5) during this time. (Author's

SHORT-CIRCUITING OF INFLOW LOW THROUGH SILVER LAKE, K,
of New York at Buffalo. Dept. of

t, and K. M. Stewart.
urces Research, Vol. 19, No. 2, p 529-1983. 10 Fig, 2 Tab, 41 Ref.

: *Water circulation, Lakes, Silver York, Water level, Short-circuiting, ets, Mixing, Retention, Nutrients.

nity of the major inlet to the outlet of e, New York, permits some short-circ ne incoming flow. This feature, unusual t in lakes, is verified with data which when the inlet and outlet waters resem- ner more than they do the lake. Rhoda- and some natural inorganic chemical ve been used as tracers to illustrate this n. The case for short-circuiting appears uring some low inflows and is compli- ater level manipulation at a small dam et and withdrawal of water from the mmunities. The significance of short- or this eutrophic/mesotrophic lake is ncoming nutrients from the rich agricul- shed bypass the lake. Determinations of me and nutrient loading for such lakes complex. The governance of trophic in this and similar lakes, or in parts of may be influenced more by such in- ixing than generally considered. (Au- act)

ITY TO ACIDIFICATION OF LAKES FLAT TOPS WILDERNESS AREA, O,
Survey, Lakewood, CO.
and D. B. Adams.
urces Research, Vol. 19, No. 2, p 346-1983. 3 Fig, 3 Tab, 8 Ref.

: *Alkalinity, *Lakes, Colorado, Acid tain lakes, Altitude, Buffering, Water- tralization, Dilution, Drainage area.

f regionally plentiful coal and oil shale n the western United States may result ease of atmospheric emissions in and northwestern Colorado, as may smelt- increase in population. Such emissions previously associated with water quality n from acid rain. Lakes of the Flat Tops Area in northwestern Colorado are acidification if precipitation in the area s acidic as that of the northeastern tes. About 50% of the titration alkalinity t poorly buffered lakes is from dilution nt acid rather than neutralization. Alka- adily predicted from watershed charac- cluding lake altitude, fraction of exposed nd drainage area. Alkalinity values as micro eq/l occur in the higher-altitude he basis of alkalinity titration curves for tudied, an alkalinity of 200 micro eq/l or necessary to adequately protect a lake ipitation as acidic as that of the north- nited States. Most lakes at altitudes of greater are predicted to have alkalinity 200 micro eq/l or less. About 370 lakes total surface area of about 157 ha are to be sensitive to acidification. (Moore-

AL LIMNOLOGICAL CHANGE AND LANKTON PRODUCTION IN OHA- HYDRO-ELECTRIC LAKE ON THE O RIVER,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
G. W. Coulter, J. Davies, and S. Pickmere.
New Zealand Journal of Marine and Freshwater Research, Vol. 17, No. 2, p 169-183, June, 1983. 8 Fig, 4 Tab, 35 Ref.

Descriptors: *Limnology, *Phytoplankton, Nutrients, Chlorophyll a, Seasonal variation, Flow rate, Water temperature, Stratification, Biomass, Nitrates, Phosphorus, Hydroelectric power, Reservoir operation, Environmental effects, Primary productivity, Lake Ohakuri.

The Waikato River originates in oligotrophic Lake Taupo, but becomes chemically enriched before reaching Lake Ohakuri, where phytoplankton increases dramatically. Data were collected over 2 years, including daily measurement for 1 year of N, P, Si, and chlorophyll a in water leaving the lake. The hypolimnion remained stagnant in summer, and inorganic-N peaked after lake overturn. NO3-N showed a marked seasonal cycle in concentration and total flux in water leaving the lake, which may not correspond with input rates from the catchment. Melosira granulata var. angustissima dominated the phytoplankton in summer, and Chlamydomonas spp. and Cyclotella spp. in winter. In summer, weekly cycles in algal abundance, which correlated inversely with NO3-N and DRP (dissolved reactive phosphorus) concentrations, were dictated by weekly flow cycles resulting from the requirements of hydro-electric power generation. Flow rate and temperature appear the dominant factors regulating phytoplankton abundance. Shorter residence time and probably slower growth rates in winter, and longer residence and more rapid growth in summer interact critically. Phytoplankton production in river lakes such as Ohakuri with a brief water residence time is more appropriately represented by the mass flow of algal material through it than by the abundance of the standing stock. Summer phytoplankton biomass in Lake Ohakuri is equivalent only to a mildly eutrophic condition, but the amount generated and then lost from the lake is equivalent to production in a lake of much higher trophic status in a closed basin. (Author's abstract)
W84-01372

RESPONSE OF PLANKTONIC ROTIFERS TO THE EUTROPHICATION PROCESS AND TO THE AUTUMNAL SHIFT OF BLOOMS IN LAKE BIWA, JAPAN. I. CHANGES IN ABUNDANCE AND COMPOSITION OF ROTIFERS,
Polish Academy of Sciences, Warsaw. Inst. of Ecology.
A. Hillbricht-Ilkowska.
Japanese Journal of Limnology, Vol. 44, No. 2, p 93-106, April, 1983. 5 Fig, 6 Tab, 21 Ref.

Descriptors: *Eutrophication, *Rotifers, Lake Biwa, Plankton, Seasonal variation, Diatoms, Chlorophyta, Water temperature, Foods.

The density of planktonic rotifers in Lake Biwa was 100-3,000/l from September to December, 1980. This level is remarkably higher than that previously reported by Yamamoto, who noted no more than 10-600/l, although the northern basin (LBN) has been, in general, regarded as having lower values than the southern basin (LBS). An increase in population density was observed in the following species: small and fine particle feeders like Keratella cochlearis, Collotheca pelagica, Brachionus species group and K. quadrata; and grasspers such as Polyarthra vulgaris and P. dolichoptera. The long-term changes may well be evidence for the accelerated eutrophication of Lake Biwa. The actual trophic difference between both basins in reflected in 1) greater abundance of rotifers (maximum of 3,000/l); 2) greater contribution of K. cochlearis (especially f. tecta = 50%); and 3) higher Trophic State Index (TSI = 75) in the LBS; on the contrary, corresponding values were 300/l, K. cochlearis f. tecta = 1% and TSI = 46, respectively, in the LBN. During the autumnal shift of the blooms from green algae to diatoms coupled with the autumnal cooling of the water there was a succession of dominant species with food selection of different size particles: K. cochlearis, Polyarthra spp., K. quadrata. In November, a considerable increase in the number of K. cochlearis f. tecta was recognized. (Author's abstract)
W84-01373

RESPONSE OF PLANKTONIC ROTIFERS TO THE EUTROPHICATION PROCESS AND TO THE AUTUMNAL SHIFT OF BLOOMS IN LAKE BIWA, JAPAN. II. CHANGES IN FECUNDITY AND TURNOVER TIME OF THE DOMINANT SPECIES,
Polish Academy of Sciences, Warsaw. Inst. of Ecology.
A. Hillbricht-Ilkowska.
Japanese Journal of Limnology, Vol. 44, No. 2, p 107-115, April, 1983. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Rotifers, *Eutrophication, Lake Biwa, Seasonal variation, Reproduction, Water temperature, Plankton, Foods, Detritus, Algae.

The egg-female ratio, i.e. the ratio of the numbers of amictic eggs to the number of females was analyzed for the dominant species, Keratella cochlearis, K. quadrata and Polyarthra vulgaris together with P. dolichoptera from September to December 1980 at six stations in the southern part of Lake Biwa. Irrespective of the decrease in water temperature from about 26 C in September to about 6 C in December, there was a considerable increase in the fecundity of these species in November. It was probably the effect of the temporal improvement of the food conditions, i.e., the increased detritus particles and nanoplanktonic algae. The birth rates were calculated as well as the tentative number of parthenogenetic generations for each sampling interval and for the whole sampling period; it ranged from 15 to 29 generations for K. cochlearis, 12-30 for P. dolichoptera and P. vulgaris, and 2-12 for K. quadrata, varying for each stations. (Author's abstract)
W84-01374

IMPACT ON DAPHNIA PULEX OF PREDATION BY YOUNG YELLOW PERCH IN ONEIDA LAKE, NEW YORK,
E. L. Mills, and J. L. Forney.
Transactions of the American Fisheries Society, Vol. 112, No. 2A, p 154-161, March, 1983. 2 Fig, 2 Tab, 26 Ref. F-17-R.

Descriptors: *Predation, Population dynamics, Daphnia, Perch, Biomass, Fish food organisms, Oneida Lake, New York.

The response of a Daphnia pulex population to fluctuations in abundance of young (age-0) yellow perch Perca flavescens was examined in Oneida Lake, New York, 1975-1979. Comparisons of yellow perch biomass and D. pulex abundance suggested daphnid populations could tolerate predation by 10 kg of young fish/hectare but reproduction could not compensate for predation when biomass of young exceeded 20-40 kg/hectare. Consumption by young yellow perch exceeded D. pulex production in 1975 and 1977, when daphnids disappeared, but maximum daily consumption was less than 27% of production in 1976 when daphnids were abundant through late summer. Since 1968, D. pulex populations have persisted through late summer in years when young yellow perch were scarce and disappeared when young were abundant. The decisive role of young yellow perch in the regulation of D. pulex abundance is of importance to the broader fish community in Oneida Lake. (Author's abstract)
W84-01400

2I. Water In Plants

EFFECTS OF BIOCLIMATE AND SOIL USE ON WATER BUDGET TERMS IN WEST AFRICA (INFLUENCE DU BIOCLIMAT ET DE L'AMENAGEMENT DES SOLS SUR LES ELEMENTS DU BILAN HYDRIQUE EN AFRIQUE DE L'OUEST),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 2A.
W84-01104

Group 2I—Water In Plants

EFFECT OF WATER-TABLE DEPTH ON SHOOT GROWTH, ROOT GROWTH, AND NODULATION OF MYRICA GALE SEEDLINGS,
Harvard Univ., Petersham, MA. Harvard Forest.
C. R. Schwintzer, and S. A. Lancelle.
Journal of Ecology, Vol. 71, No. 2, p 489-501, July, 1983. 5 Fig, 2 Tab, 31 Ref. DE777-02249.

Descriptors: *Water table gradient, *Growth, Peat soils, Sand, Soil types, Nitrogen fixation, Biomass, Root development, Oxygen uptake, Phenology.

Seedlings of Myrica gale, an actinorhizal dinitrogen-fixing shrub, were grown in two boxes with a gradient of water-table depth from 3-79 cm. The boxes were outdoors but sheltered from rain by translucent roofs. One box was filled with sand and the other with peat. The seedlings were harvested in autumn shortly before leaf-fall. The plants produced maximum biomass at water-table depths between 10 cm and 35 cm on both substrata but the total amounts produced were substantially greater on peat than on sand. Shoot-root quotients decreased with increasing water-table depth on both substrata but were much larger on sand. The roots did not penetrate below the water table and the orientation of the major lateral roots changed from primarily horizontal to semi-vertical with increasing water-table depth. Nodules formed 6-7% of the total seedling biomass in the wettest soils and decreased to 1% in the driest. Nodule roots showed maximum development in the wettest soils where they were relatively long and thick, and emerged through the surface into the air above. This is consistent with a functional role in enhancing nodule oxygen uptake under oxygen-limiting conditions. The considerable phenotypic plasticity in response to moisture and aeration exhibited by M. gale appears to be a valuable adaption in its natural habitat where the water level often fluctuates. (Author's abstract)
W84-01177

SOME RELATIONSHIPS BETWEEN ENVIRONMENTAL RELIABILITY AND SEED DORMANCY IN DESERT ANNUAL PLANTS,
New Mexico State Univ., Las Cruces. Dept. of Biology.
K. E. Freas, and P. R. Kemp.
Journal of Ecology, Vol. 71, No. 1, p 211-217, March, 1983. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Desert plants, *Rainfall, Germination, Seasonal variation, Model studies, Seeds, Water controlled dormancy, Ecology.

There are two groups of annual species that grow in the northern Chihuahuan Desert of North America. Plants in one group germinate and complete their life cycle in late summer. Those in the other germinate in winter or early spring and complete their life cycle in the spring. The late summer season is characterized by abundant and reliable rain, while the winter-spring season has less abundant and less reliable rain. Several theoretical models have been suggested which predict that annual plants from uncertain environments may or may not have evolved innate dormancy to offset the possibility of population extinction due to complete germination followed by complete mortality under severely unfavorable conditions. These models were tested with a comparative experiment examining the germination responses of seeds collected from an annual species which grows during the more reliable summer season and two annual species which grow during the less reliable winter-spring season. The summer annual species does not have a genetically fixed innate dormancy, but the two winter annual species apparently have evolved a genetically controlled innate dormancy. All three annual species exhibited environmentally-controlled seed dormancy with respect to amount of rainfall. Seeds germinated only when the equivalent of more than 10 mm of rain fell. Above 15 mm of simulated rain, germination was positively correlated with increasing amount of rain in all three species. The importance of innate dormancy, water-controlled dormancy, and seed dispersal to the long-term survival of these species is discussed. (Author's abstract)
W84-01182

DISCRIMINATION OF GROWTH AND WATER STRESS IN WHEAT BY VARIOUS VEGETATION INDICES THROUGH CLEAR AND TURBID ATMOSPHERES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. D. Jackson, P. N. Slater, and P. J. Pinter, Jr.
Remote Sensing of Environment, Vol. 13, No. 3, p 187-208, July, 1983. 19 Fig, 2 Tab, 17 Ref. 12-14-5001-38.

Descriptors: *Remote sensing, *Reflectance, *Water stress, Wheat, Drought, Satellite technology, Optical properties, Vegetation, Simulation.

Reflectance data were obtained over a drought-stressed and a well-watered wheat plot with a hand-held radiometer having bands similar to the MSS bands of the Landsat satellites. Data for 48 clear days were interpolated to yield reflectance values for each day of the growing season, from planting until harvest. With an atmospheric path radiance model and Landsat 2 calibration data, the reflectances were used to simulate Landsat digital counts (not quantized) for the four Landsat bands for each day of the growing season, through a clear (= 100-km meteorological range) and a turbid (= 10-km meteorological range) atmosphere. Several ratios and linear combinations of bands were calculated using the simulated data, then assessed for their relative ability to discriminate vegetative growth and plant stress through the two atmospheres. The results showed that water stress was not detected by any of the indices until after growth was retarded, and the sensitivity of the various indices to vegetation depended on plant growth stage and atmospheric path radiance. (Author's abstract)
W84-01505

THE INFLUENCE OF SNOW ON GROWTH AND SURVIVAL OF PLANTED TREES,
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
W. Frey.
Arctic and Alpine Research, Vol. 15, No. 2, p 241-251, May, 1983. 10 Fig, 5 Tab, 37 Ref.

Descriptors: *Snow cover, *Trees, Plant water potentials, Water stress, Seedlings, Subalpine zone, Dessication, Flushing.

In the subalpine zone at Davos, Switzerland, a trial plot of seven tree species was kept artificially snow free during two winter periods and compared with an equivalent trial plot under natural snow cover. Periodic measurements of water potential and water content showed that, during the winter period, there is a higher water stress in the snow free plants, especially Norway spruce (Picea abies (L.) Karst), and deciduous species, including European larch (Larix decidua Mill.). Seedlings of these species showed serious desiccation and an increased mortality compared with the snow-covered seedlings. Desiccation occurred predominantly on the parts of the snow-free seedlings that were exposed to the sun. Flushing in spring was retarded in the snow-free plot. All measured growth parameters showed more favorable results in the snow-covered plot. Sufficient snow cover is therefore a very important factor for the success of young seedlings in the subalpine zone, especially for Norway spruce, European larch, and deciduous broadleaf species. (Author's abstract)
W84-01382

2J. Erosion and Sedimentation

ANALYSIS METHOD FOR STUDYING SEDIMENTATION PATTERNS,
Coastal Engineering Research Center, Fort Belvoir, VA.
J. R. Weggel.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 2, p 256-260, May 1983. 4 Fig.

Descriptors: *Sediment distribution, *Shoals, *Scour, *Water depth, Navigation channels, Harbors, Estuaries, Rivers, Dredging, Bathymetry, *Florida, Mill Cove, St. Johns River.

It is often necessary to quantify changes i
depth brought about by either sedimenta
scour in enclosed or semi-enclosed water
Historical sedimentation patterns can be
estimate future patterns and then used to de
future dredging requirements for river, harb
estuary navigation channels. Comparison
area vs. depth curves provides a method fo
mining the depths in which sedimentati
scour are occurring. The area between tw
curves divided by the time difference betw
two surveys for which the curves are cons
will give the shoaling or scour rate. Shoa
scour rates can be determined as a func
water depth simply by taking the differer
tween the ordinates of the two curves divi
the time between the two surveys for any
water depth. This analysis can provide insig
sedimentation trends for enclosed for se
closed water bodies that routine plots of bat
ric changes cannot. Mill Cove, a semi-en
basin adjacent to the St. Johns River in Flo
used as an example. (Moore-IVI)
W84-01061

**DETERMINATION OF THE CROSS SEC
OF CANAL CHANNELS FOR SEDI
TRANSPORT,**
For primary bibliographic entry see Field 8B
W84-01068

**MOVEMENT OF FINE GRAINS IN TH
CINITY OF WELL SCREENS,**
Vizgazdalkodasi Tudomanyos Kutato Inteze
dapest (Hungary).
For primary bibliographic entry see Field 8B
W84-01101

**SEDIMENT SUSPENSION WITH RIPI
BED,**
Saitama Univ. (Japan). Dept. of Foundation
neering.
For primary bibliographic entry see Field 8B.
W84-01131

**SUSPENDED SEDIMENT PROFILE FOR
COVERED FLOWS,**
Department of the Environment, Burlington
tario). Hydrology Div.
B. G. Krishnappan.
Journal of Hydraulic Engineering, Vol. 109, N
p 385-399, March, 1983. 12 Fig, 3 Tab, 10

Descriptors: *Suspended sediments, *Turb
flows, *Ice cover, Free surfaces, Fall velo
Shear velocity, Roughness coefficient, Mathe
ical models.

The vertical distribution of the suspended sedi
in two-dimensional, uniform, and fully devel
turbulent flows under ice cover is formulated
the results of the kappa-epsilon turbulence m
of Launder and Spalding. Three sets of distribu
curves each corresponding to a particular valu
the ratio between the ice cover roughness and
roughness are presented in a form similar to
distribution curves of H. Rouse (Trans. ASCE
463, 1937) for free-surface flows. For the s
value of the ratio between the shear velocity
the fall velocity of sediment particles, the rel
concentration is less in ice-covered flows tha
free-surface flows. Under similar conditions,
relative concentration of suspended sediment
creases as the ratio of the ice cover roughnes
bed roughness increases. The agreement betw
the present formulation and the measurem
found in the literature is favorable. (Author's
stract)
W84-01135

**STEADY BED MATERIAL TRANSPORT
ALLUVIAL CHANNELS,**
Ministry of Agriculture and Water, Riyadh (Sa
Arabia).
G. Holtorff.
Journal of Hydraulic Engineering, Vol. 109, No
p 368-384, March, 1983. 8 Fig, 3 Tab, 9 R

s: *Sediment transport, *Alluvial chan- mechanics, Flow rates, Erosion, Sus- d, Bed load.

s developed to predict the bed material eady fluid and sediment flow in alluvial ased on the fact that the total power of nd sediment flow is constant. The total a sediment-laden stream is consumed by f the fluid, the suspended load, and the The bedrock power is the shear force to the bedload in motion times the mean velocity of the bedload particles. The load power is the submerged weight of es in suspension, times their fall velocity wer which is caused by increased damp- urbulence generation in the presence of iment concentrations near the channel cordance with the transport mechanism ed load and bedload, equations are de- permit the prediction of the rate of load provided the fluid and sediment ady. The mass of the bedload particles in d that of the suspended load particles in depends on the erosive and diffusive he flow, and the power of the sediment Since the erosive and diffusive power of decreases as the rate of the sediment increases, the solution of the problem defining the flow stage where the trans- ity of sediment is maximum. The theory t transport outlined is well supported by tal evidence. (Baker-IVI)
6

ILIBRIUM BEDLOAD TRANSPORT DY FLOWS,
of Works and Development, Hamilton land). Water and Soil Science Centre. , and A. J. Sutherland.
Hydraulic Engineering, Vol. 109, No. 3, , March, 1983. 8 Fig, 2 Tab, 21 Ref.

rs: *Bed load, *Mathematical models, cour, Flow velocity, *Sediment trans- ion, Alluvial channels.

nse of a gravel bed reach to imposed ws is examined under nonequilibrium , where the bedload inflow is zero. Ex- l research to date and general mathemat- ls for nonequilibrium alluvial conditions ved. An experimental program was de- examine the transient bed response for each lengths. Also, measured nonequili- load transport rates were compared with le local equilibrium capacity rates at se- e intervals and distances for a common v velocity. Differences occurred between rium transport rates and comparable n capacity rates at a maximum near the of the reach but diminishing towards the m end of the local scour hole. This riation of the transport rate deficit exists he flow requires a finite length of bed to icient bed material to satisfy its equilibri- ort capacity. Consequently, mathemat- l performance will be poor in the local e region. (Author's abstract)
7

TER MATRIC POTENTIAL EFFECTS REGATE STABILITY,
ricultural and Home Economics Experi- ion, Ames.
ncis, and R. M. Cruse.
ce Society of America Journal, Vol. 47, 78-581, May-June, 1983. 1 Fig, 2 Tab, 14

rs: *Soil water, *Soil aggregates, Soil ent, Soil erosion, Rain, Manure, Crop n, Aggregate stability.

t of soil water matric potential (psi m) is idered with most techniques utilized to aggregate stability. Rather, aggregate sta- ally is measured at psi m of 0 Pa or at an psi m. The objective of this study was to e psi m effects, in the range of 0 to -3,000 ability of natural soil aggregates obtained from a fencerow and from plots having a range of management histories. Aggregate stability, considered inversely related to the mass of soil detached by impact of falling water drops, increase markedly as psi m decreased from 0 to -500 Pa. Similar psi m changes at psi m $<$ -500 Pa had smaller effects on aggregate stability. Significant differences in stability of aggregates obtained from plots with different cropping and/or manuring histories, were sometimes undetectable at psi m $<$ -500 Pa but were more consistently detected at psi m = Pa. Data from this study indicate that aggregate stability is very sensitive to psi m particularly at psi m near zero. Techniques for comparing aggregate stability between soils or soil treatments should ensure equal values of psi m exist for all aggregates. Measurements made over a range of psi m should yield better comparisons of aggregate stability between soils than measurements made at one psi m. (Author's abstract)
W84-01161

SEMI-EMPIRICAL CORRELATIONS FOR FINE AND COARSE COHESIONLESS SEDIMENT TRANSPORT,
Lamar Univ., Beaumont, TX.
P. A. Mantz.
Proceedings of the Institution of Civil Engineers, Vol. 75, p 1-33, 1983. 6 Fig, 13 Tab, 28 Ref.

Descriptors: *Sediment transport, *Hydraulic resistance, *Bedform development, Bed load, Suspension, Suspended load, Flow velocity, Flow depth.

A total of 54 laboratory experiments were conducted with fine, cohesionless, silica sediment under water flow. The equilibrium sediment transport, bedform development and hydraulic resistance for three grades of almost equal-sized silica solids (of median diameter 0.018 mm, 0.042 mm and 0.123 mm) were investigated for three conditions of flow depth (0.03 m, 0.06 m and 0.12 m) and for six conditions of average flow velocity (from 0.2 to 0.7 m/s at increments of 0.1 m/s). Experiments were conducted in a 10 m long and 0.30 m wide recirculating, tilting, laboratory flume which contained direct town supply, softened water. The water chemistry was controlled so that the sediment behaved as if cohesionless, and the water temperature was allowed to reach an equilibrium maximum of about 25 C. The sediment transport was analysed according to the streampower theory developed by Bagnold. The theory was extended for these shallow flows, and it was assumed that the rate of applied flow energy was dissipated partly by the friction and moving bed load solids, partly by the turbulence associated with bedforms, partly by the gravitational settling of suspended load solids, and partly by the friction of the unimpeded flow. Unique correlations were subsequently derived for the work rates associated with the moving bed load or suspended load, and the streampower excess which excluded that necessary for incipient transport or incipient suspension. An analysis of readily available field data was made for comparison with the laboratory data. Bed load data were abstracted from a recent collation by Bagnold. The data covered a coarse-grain diameter range from 0.3 mm to 300 mm, and a large flow-depth range from 0.10 m to 12 m. Suspended load data were abstracted from river data monitored and collated by the US Geological Survey. They included both shallow and deep rivers (ranging from 0.2 m to 9 m in depth) from the States of Alaska, New Mexico and Arizona. (Author's abstract)
W84-01248

AN APPLICATION OF OPERATIONS RESEARCH METHODS TO BEACH RENOURISHMENT PROJECTS,
University of South Florida, Tampa.
E. W. Shows.
Water Resources Bulletin, Vol. 19, No. 2, p 249-253, April, 1983. 1 Tab, 6 Ref.

Descriptors: *Beach erosion, *Mathematical models, *Surveys, Florida, Erosion control, Capital costs, Recreation, Economic feasibility.

Mathematical models have been widely used in business to minimize cost and maximize profit. In this paper such models are used to help determine the optimum strategy for a beach renourishment project including the initial and subsequent fill quantities and the length of a complete renourishment cycle. The importance of considering economic factors is emphasized, and the sensitivity of the optimal values to changes in the basic parameters of the models are discussed. The possible extensions and limitations of the models are considered. (Author's abstract)
W84-01279

CONFLUENCE SCOUR IN COARSE BRAIDED STREAMS,
Alberta Univ., Edmonton. Dept. of Geography.
P. Ashmore, and G. Parker.
Water Resources Research, Vol. 19, No. 2, p 392-402, April, 1983. 10 Fig, 3 Tab, 35 Ref.

Descriptors: *Scour, *Braided streams, Abrasion, Erosion, Model studies, Confluent streams, Reynolds numbers, Sand.

Laboratory modeling was performed of confluence scour in coarse braided streams and the results were compared with field data using an appropriate scaling law. The major controls of scour depth are isolated and may be used for design predictions. The findings suggest that confluence scour in gravel braided streams can be modeled reasonably well in coarse, noncohesive bed material. Scale effects, presumably resulting from low model Reynolds numbers, are not greater than about 10%. Generally speaking, the angle of confluence is the major influence on scour depth, but the relationship is modified slightly by the relative discharge of the two channels when this difference becomes large. If one channel approaches twice the size of the other, the relationship with the angle of confluence becomes poor. For angles between 30 and 90 degrees, the relationship is almost linear. Maximum relative scour depth rarely exceeds 6.0. This relationship covers the most common naturally occurring confluence angles. The influence of bed material sorting and cohesiveness is apparent in comparing data sets from different sources. Cohesive bed material gives markedly lower depths than noncohesive material, while poorly sorted sand may give slightly lower depths than well sorted sand of the same mean size. Coarse lag material is absent from the scour holes even in poorly sorted sand. Confluence scour depth is clearly independent of valley parameters for the range of measurements reported. However, there is no reason to believe that the same scour relation should apply to such cases as large, low-slope sand bed braided streams. (Baker-IVI)
W84-01330

DENSITIES OF WET AGGREGATED SEDIMENT FROM DIFFERENT TEXTURED SOILS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
F. E. Rhoton, L. D. Meyer, and F. D. Whisler.
Soil Science Society of America Journal, Vol. 27, No. 3, p 576-578, May-June, 1983. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Sediment transport, *Soil density, *Soil aggregates, Soil texture, Sediment density, Rain, Deposition, Interstitial water.

The density of wet aggregated sediment is a major factor controlling its fluvial transport and deposition. Since this property varies depending on the volume of aggregate pores filled with water, the use of dry aggregate densities in sediment transport studies may result in significant underestimations of wet sediment densities and consequently overestimations of transport distances. Therefore, this study was conducted to measure the densities of wet aggregates that exist during fluvial transport of sediment from agricultural soils. Samples from six soils, ranging in texture from silty clay to sandy loam, were wetted and agitated to simulate the stresses of raindrop impact. Two size ranges (1.00 to 0.50, and 0.50 to 0.25 mm) were collected from this sediment by wet sieving, then drained at a suction of 50 cm of water and weighed. The sedi-

ment volume was measured to the nearest 0.05 mL in a displacement vessel. Wet aggregate densities approximated 2.0 Mg/cu m and varied little among soils, or between the two size ranges. No variations in aggregate density could be directly attributed to differences in aggregate textures. (Author's abstract)
W84-01366

2K. Chemical Processes

STUDIES ON THE ANODIC STRIPPING VOLTAMMETRY OF LEAD IN POLLUTED ESTUARINE WATERS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica.
For primary bibliographic entry see Field 5A.
W84-01060

LIQUID CHROMATOGRAPHIC DETERMINATION OF GLYPHOSATE IN FORTIFIED SOIL AND WATER SAMPLES,
Agricultural Research Service, Beltsville, MD. Weed Science Laboratory.
For primary bibliographic entry see Field 5A.
W84-01079

LESSONS FROM THE SILICA 'DECLINE' IN LAKE MICHIGAN,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 5A.
W84-01083

MULTIELEMENTAL AND HYDROCHEMICAL STUDY OF HOLY ZAMZAM WATER,
A. Naeem, M. Y. Alsanussi, and A. A. Almohandis.
Journal of the New England Water Works Association, Vol. 97, No. 2, p 158-169, June, 1983. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Well water, *Saudi Arabia, *Water chemistry, Drinking water, Heavy metals, Minerals, *Water analysis.

A water sample from the Zamzam Well, located in the holy city of Makkah in the Western Province of the Kingdom of Saudi Arabia, was analyzed with the help of neutron activation, inductivity coupled plasma and classical techniques. Multielement composition, the hydro-chemical properties, and the potability of the water from a chemical viewpoint are reported. A total of 34 elements have been found with calcium (Ca), magnesium (Mg), sodium (Na), and chloride (Cl) in the highest concentrations. The elements Sb, Be, Bi, Br, Co, I, Mo are < 0.01 ppm. Only traces of Cr, Mn, and Ti have been found in Zamzam water. Hydrochemical study of Zamzam water indicates that it is a sodium chloride water and of meteoritic origin. The four toxic elements arsenic (As), cadmium (Cd), lead (Pb), and selenium (Se) have been found below the danger level of human consumption. Chemically Zamzam water is suitable for drinking purposes. (Author's abstract)
W84-01095

INOSITOL-PHOSPHATES; HYDROLYSIS, STABILITY AND ANALYSIS,
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Technology.
W. Potman, and L. Lijklema.
Water Research, Vol. 17, No. 4, p 411-414, April, 1983. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Phosphates, *Bottom sediments, *Hydrolysis, Electrophoresis, Hydrogen ion concentration, Cycling nutrients, Detritus.

Inositol-phosphates are a class of phosphate-rich compounds occuring in sediments and aquatic systems. Their extraction from sediments and plant material and subsequent separation should be performed under conditions where these compounds are stable, whereas quantitative estimation of the individual components requires complete hydrolysis but without degradation of the inositol formed. The study showed that chemical hydrolysis can be performed at a low pH and 100 C. Extractions should be performed by preference in alkaline solutions at moderate temperatures. (Author's abstract)
W84-01260

TRANSLOCATION OF INORGANIC/ORGANIC MERCURY IN A MODEL AQUATIC SYSTEM,
Hyogo Prefecture Public Health Inst., Kobe (Japan).
J. Yamamoto, Y. Kaneda, Y. Hikasa, and E. Takabatake.
Water Research, Vol. 17, No. 4, p 435-440, April, 1983. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Organomercury compounds, *Bottom sediments, Spectrophotometry, Path of pollutants, Translocation, Model studies.

The volatile organic mercury at subnanogram level was determined by steam distillation Magos treatment and flameless atomic absorption spectrophotometry after preconcentration with silvered sand. By this technique, down to 0.1 ng of methyl mercury can be determined with good precision (+ or - 5%). Application of the technique to our aquatic model system made clear that much higher ratio of organic mercury (nearly 8%) to the total one was in water overlying organic sediment than the water sample overlying sandy sediment (approximately 3.5%). In natural water, therefore, it would seem that the content of organomercurials are less than 10% to that of total mercury. (Author's abstract)
W84-01271

OXYGEN ISOTYPE RATIOS IN GERMAN GROUNDWATER,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Radioagronomie.
H. Forstel, and H. Hutzen.
Nature, Vol. 304, No. 18, p 614-616, August, 1983. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Oxygen isotopes, *Groundwater, Precipitation, Spatial distribution, Temperature, Altitude, Germany.

The natural variation in the O18/O16 ratio in precipitation has a characteristic global pattern, a continuous decrease from the Equator towards the polar regions, corresponding to the worldwide distribution of the local mean annual temperature. This global pattern is not, however, sensitive enough to predict the local O18/O16 ratio in precipitation. A survey of groundwater throughout the Federal Republic of Germany was obtained from about 900 samples of the municipal water supply. A multicorrelation study demonstrates that both distance from the coast and height above sea level determine the local O18/O16 ratio, and that this ratio generally decreases from the northern coast towards the southern mountainous region. The geographical variation in the O18/O16 ratio may serve as a basis for paleoclimatological, plant-physiological and food-analytical applications. (Moore-IVI)
W84-01303

SOME CHARACTERISTICS OF CHEMICAL PRECIPITATION,
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
A. W. Hogan.
Tellus, Vol. 35B, No. 2, p 121-130, April, 1983. 4 Fig, 2 Tab, 13 Ref. RAD 00023.

Descriptors: *Chemical precipitation, *Rain, Sodium, Chlorides, Storms, Chemistry of precipitation, Convective precipitation, Precipitation, Ions.

Two very dissimilar cold frontal occulusions deposited 6 mm and 60 mm of rain respectively at an observatory in the rural northeastern U.S.A. Water precipitation was carefully observed, in conjunction with other meteorological parameters, through both storm systems. The concentration of several ionic substances were measured i
mens of rain water collected during mete
cally homogeneous portions of the two
The rate of chemical precipitation was det
with respect to water precipitation. This r
constant during the prefrontal stage of both
and increased following cold frontal passag
convective side of the systems. Analyses
time rate of chemical precipitation showed
constant during the continuous rain of
Examinations of the ratio of chloride to
through the time history of the storms show
to agree with a transport model postula
Rossby and Egner (1955). Although th
storms varied considerably with respect to c
tivity and prevailing flow, the total amount
several ions precipitated were directly prop
al to the amount of water precipitated. (A
abstract)
W84-01309

PRECIPITATION CHEMISTRY AT THE CELL EXPERIMENTAL FOREST IN NO CENTRAL MINNESOTA,
North Central Forest Experiment Station, Rapids, MN. Forestry Sciences Lab.
E. S. Verry.
Water Resources Research, Vol. 19, No. 2, 462, April, 1983. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Precipitation chemistry, *Snow, Ions, Hydrogen ion concentration, A nium, Sodium, Calcium, Sulfates, Nitrates, rain, Acidity, Alkalinity.

Concentration (milligrams and microequiv per liter) values are presented for major io curring in rain and snow from July 1978 t 1980. Ammonium, sodium, and calcium a largest equivalent weight cations which are l balanced by sulfate and nitrate anions. Hydro the fourth most abundant cation; but high bined concentrations of other cations in 27% sample events mask positive correlations wit hydrogen concentrations. Field-measured pH aged 4.3, but the range (3.5 to 6.5) fluctuated a combination of earth and air mass condi When high cation (and anion) data are deleted pH correlates well with high nitrate. Sulfate centrations are similar to those measured in and do not correlate with pH. Calcium and, lesser extent, ammonium tend to increase values. High nitrate values also correlate posit with high excess acidity, while high sodium calcium values correlate with high excess al ity. (Author's abstract)
W84-01345

CHEMICAL COMPOSITION OF NATU WATERS IN THE KINASA LANDSLIDE A
Nagoya Univ. (Japan). Water Research Inst.
Y. Kitano, and S. Nakamura.
Japanese Journal of Limnology, Vol. 44, No. 132-138, April, 1983. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Chemical composition, *Na waters, *Landslides, Kinasa, Snowmelt, Sulf Carbon dioxide, Carbonates, Groundwater.

Waters were collected in the Kinasa landslide to confirm whether the source of the waters only rain and snow melt water or if deep gro water was also present. Chloride concentra was very low and uniform. Therefore, the ch cal constituents in the waters are principally re ed to the dissolution from rocky materials thro chemical and weathering processes. Bicarbo and sulfate concentrations of the natural wa were high and varied. It is presumed that ro materials are weathered chemically by car dioxide underground. Calcium and magnesium were dissolved preferentially from the rocky m rial and carbon dioxide changes to bicarbo ions. At that time silicate minerals change into c minerals. The origin of carbon dioxide und ground is assumed to be in the volcanic activity the area. Calcium and magnesium concentration natural waters may well indicate the extent of chemical weathering of rocky materials in cont with the waters and also the extent of the for tion of clay minerals. Natural waters in landsl

tertiary rocks have been known to be sulfate concentration derived mostly e oxidation of iron sulfides. (Baker-IVI)

uaries

TER INTRUSION IN THE NILE

y bibliographic entry see Field 4B.

IZING GHYBEN-HERZBERG IN- WITH RIGOROUS SOLUTIONS,
y bibliographic entry see Field 4B.

G PROCESSES IN NAVIGABLE

Society of Civil Engineers, New York. mittee on Causes and Effects of Shoaling le Waters.
y bibliographic entry see Field 8B.

CE OF WATER MOTION ON THE UTION AND TRANSPORT OF MATE- A SALT MARSH ESTUARY,
ustralia Univ., Nedlands. Dept. of Civil g.
r, T. Berman, R. R. Christian, E. B. D. E. Whitney.
and Oceanography, Vol. 28, No. 2, p larch, 1983. 8 Fig, 28 Ref.

s: *Estuaries, *Salt marshes, Boundary Water circulation, Fluctuations, Mixing, cycling, Ammonium, Organic carbon, Turbulence, Duplin River, Georgia.

approach is presented of ordering the s of the dominant fluxes of material in an d then accordingly choosing the spatial oral resolution of the sampling program. y bounds can be derived for the internal times, boundary exchange rates, and export fluxes of a particular substance m measurements of the standing stock the estuary water. Application of this gy to an experiment in the Duplin orgia, showed that if the effects of the tion and mixing are extracted from the f a biological component, then the vari- he residual can be successfully interpret- typical summer condition it was shown onium was cycled rapidly within the ter, its distribution was very patchy, and decomposition products left the marsh; refractory dissolved organic carbon mponent was steadily exported by longi- xing while labile DOC was rapidly recy- e water; that silicate was produced in unts in the marsh and exported by longi- ixing; that particulate organic carbon tions were almost completely determined rbulence intensity in the water, and that to this internal cycling, export was of nificance. (Author's abstract)
3

G WATER DISCHARGES INTO A SEA SLOPING BED,
Electricity Generating Board, Leather- ngland). Central Electricity Research

queen, and R. W. Preston.
search, Vol. 17, No. 4, p 389-395, April, g, 7 Ref.

s: *Cooling water, *Powerplants, pollution, *Tidal effects, Temperature Slopes.

l solutions for the rise in background peratures due to the discharge of cooling m a power station are developed. Previ- has taken account of the cooling water flow rate and temperature increase through the station, the tidal excursion and residual drift, cross-tide dispersion and heat exchange between the water and atmosphere in a sea with constant depth. The treatment in the present paper incorporates the slope of the sea bed. The mathematical feature of the analysis is that a closed form for the background (or far-field) temperature distribution is obtained in terms of confluent hypergeometric functions. The parameters which define these functions involve the site hydrographic feature and cooling water system parameters. Results are presented which indicate the sensitivity of the temperature rise to bed slope and the position of the discharge. The temperature at the shore, which may be an important ecological indicator and station design parameter, decreases as the distance of the outlet from the shore increases; the effect of the bed slope on the rate of decrease is quantified. (Author's abstract)
W84-01261

AN APPLICATION OF OPERATIONS RESEARCH METHODS TO BEACH RENOURISHMENT PROJECTS,
University of South Florida, Tampa.
For primary bibliographic entry see Field 2J.
W84-01279

GROWTH RESPONSE AND SPECTRAL CHARACTERISTICS OF A SHORT SPARTINA ALTERNIFLORA SALT MARSH IRRIGATED WITH FRESHWATER AND SEWAGE EFFLUENT,
Delaware Univ., Newark. Coll. of Marine Studies.
M. A. Hardisky, R. M. Smart, and V. Klemas.
Remote Sensing of Environment, Vol. 13, No. 1, p 57-67, March, 1983. 3 Tab, 1 Fig, 35 Ref.

Descriptors: *Spartina, *Salt marshes, *Remote sensing, Growth, Satellite technology, Biomass, Nitrogen, Spectral radiance, Salinity, Effluent, Vegetation, Optical properties, Radiance, Nutrients.

A short Spartina alterniflora salt marsh was irrigated with sewage effluent and freshwater. Vegetation response to nitrogen additions in the sewage effluent and soil salinity dilution by the freshwater was monitored spectrally with a GSFC MARK II hand held radiometer. The radiometer was spectrally configured to match bands 3, 4, and 5 of the Landsat-4 Thematic Mapper. Freshwater and sewage irrigations promoted live tissue production in the marsh until October. Control areas exhibited no net live biomass production after August. Radiance data expressed as the vegetation index and the infrared index were successfully correlated to increased live leaf biomass in the treated marsh. Significant correlations were found to exist between spectral radiance data and live leaf biomass, a live-dead leaf biomass ratio or percent live leaf biomass of the experimental areas. Successful spectral detection of biomass changes resulting from some perturbation suggests remote sensing as a viable tool for stress detection in S. alterniflora salt marshes. (Author's abstract)
W84-01299

CHESAPEAKE BAY: AN UNPRECEDENTED DECLINE IN SUBMERGED AQUATIC VEGETATION,
R. J. Orth, and K. A. Moore.
Science, Vol. 222, No. 4619, p 51-53, 7 October, 1983. 2 Fig, 21 Ref.

Descriptors: *Aquatic plants, *Submerged plants, *Chesapeake Bay, Estuarine.

Data on the distribution and abundance of submerged aquatic vegetation in Chesapeake Bay indicate a significant reduction in all species in all sections of the bay during the last 15 to 20 years. This decline is unprecedented in the bay's recent history. The reduction in one major species, Zostera marina, may be greater than the decline that occurred during the pandemic demise of the 1930's. The data used to determine the past and present distribution of bay grasses were acquired from recent aerial mapping studies, field surveys, biostratigraphical analyses of estuarine sediments for seeds and pollen of bay grasses, older archived photographs, and anecdotal information. The pattern of vegetation loss has not been uniform throughout the bay. The evidence of a major, regionally isolated change in the submerged grass communities over the last 20 years suggest that this estuarine system has been undergoing an environmental stress of major proportions. Although storms may have hastened the decline in certain sections of the bay, the overall pattern appears to be one of chronic decline that began in the upriver and upper bay areas and continues to the present. (Moore-IVI)
W84-01329

TIDAL AND LOW-FREQUENCY NET DISPLACEMENT IN A COASTAL LAGOON,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
N. P. Smith.
Estuaries, Vol. 6, No. 3, p 180-189, September, 1983. 11 Fig, 16 Ref.

Descriptors: *Lagoons, *Tidal currents, Water currents, Flow, Flushing, Wind, Florida.

Four, 32-day current meter records from the Indian River lagoon, Florida, are used to characterize flow patterns along the Intracoastal Waterway in a coastal lagoon. The M2 tidal constituent amplitude decreases from 58 cm/s near the Fort Pierce Inlet to only 7 cm/s in the interior of the lagoon. The relative importance of the nontidal variance in the current meter records increases from 0.6% to 26.6% of the total over the same distance. Plots of net displacement over time intervals of one to 16 days suggest relatively rapid flushing near the inlet, but in the interior of the lagoon periods of little or no net movement are increasingly common. Low-frequency motions at all four sites are coherent with windstress over time scales in excess of approximately two days. (Author's abstract)
W84-01378

CIRCULATION CHANGES IN THE SHEEPSCOT RIVER ESTUARY, MAINE, FOLLOWING REMOVAL OF A CAUSEWAY,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
B. J. McAlice, and G. B. Jaeger, Jr.
Estuaries, Vol. 6, No. 3, p 190-199, September, 1983. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Water circulation, *Estuaries, *Tidal currents, Salinity stratification, Gravitational circulation, Causeway, Maine.

A causeway which had restricted tidal flow in a portion of the Sheepscot River estuary was removed late in 1974. Flowmeter data from moored plankton nets fished over full tidal cycles, and salinity observations made in conjunction with the net sets, were used to evaluate the effects of causeway removal on circulation in the estuary. Tidal flows in the main channel increased by almost 50%. This increase was accompanied by substantial decreases in salinity stratification and in the strength of the gravitational circulation. (Author's abstract)
W84-01379

PRODUCTIVITY, DETRITUS FLUX, AND NUTRIENT CYCLING IN A CAREX LYNGBYEI TIDAL MARSH,
British Columbia Univ., Vancouver. Westwater Research Centre.
R. U. Kistritz, K. J. Hall, and I. Yesaki.
Estuaries, Vol. 6, No. 3, p 227-236, September, 1983. 8 Fig, 34 Ref.

Descriptors: *Sedge, *Primary productivity, *Nutrient cycling, Detritus, Tidal marshes, Estuaries, Standing crop, Biomass, Nitrogen, Phosphorus, Leaching, Nutrients, Seasonal variation, British Columbia.

Net annual primary production of a sedge Carex lyngbyei dominated tidal marsh in the Fraser River estuary, British Columbia, Canada was 634 g ash-

free dry weight (AFDW) per sq m per yr (687 g dry weight per sq m per yr). Mean maximum shoot elongation during the short (May to August) growing season was 1.88 cm per day from overwintering shoots. The maximum above-ground standing crop of 690 g AFDW per sq m represented only 25% of the total below-ground biomass, which appears to be controlling most of the critical life history processes of the sedge marsh. An estimate of 14% of the aboveground standing crop was lost through leaching of dissolved organic carbon from the growing plant. Aboveground tissue losses, which were negligible during the growing season, occurred primarily via translocation in autumn and tidal export during the winter. In situ measurements showed that of the original maximum standing crop, approximately 38%, 37%, and 25% were lost by downward translocation, tidal export, and sediment burial, respectively. Based on changes in above and belowground nutrient pools, rapid spring (May to late June) uptake rates of 109 mg N per sq m per day and 23.0 mg P per sq m per day by shoots were followed by downward translocation rates of 44.8 mg N per sq m per day and 12.2 mg P per sq m per day during late June to the end of August. Aboveground leaching rates were estimated as 23.9 mg N per sq m per day and 7.8 mg P per sq m per day and belowground uptake rates as 100 mg N per sq m per day and 26 mg P per sq m per day; root uptake occurred primarily after late June. Nutrient levels in decomposing litter more than doubled over the winter period showing a pattern of nutrient enrichment characteristic of marsh ecosystems. (Author's abstract)
W84-01380

TIDAL AND SUBTIDAL WATER VOLUME EXCHANGE IN AN ESTUARINE SYSTEM,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
E. M. Swenson, and W.-S. Chuang.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 229-240, March, 1983. 8 Fig, 1 Tab, 15 Ref. DACW29-79-R-0221.

Descriptors: *Estuaries, *Tidal effects, Velocity, Tidal prism, Water exchange, Fluctuations, Water currents, Lake Pontchartrain, Louisiana.

Estuarine water movements occur over a broad range of time scales. In this study, moored current meter data were used to investigate water volume exchange in the tidal passes of Lake Pontchartrain, Louisiana on the tidal and subtidal time scales. A calibration technique, employing cross-channel measurements of water velocity, was used to calibrate the moored current meters, thus allowing for calculation of volume flow over a 35-day period. The local diurnal tide accounted for 50% of the total volume exchange, the rest being due to subtidal events (frontal passage). This subtidal exchange occurs primarily as large-scale events characterized by volume fluxes up to six times greater than the normal tidal prism. Neglecting this subtidal component in the determination of the volume fluxes for a system such as Lake Pontchartrain, could result in substantial underestimation (by as much as 50%) of these volumes and their corresponding material fluxes. (Author's abstract)
W84-01383

SOME FEATURES OF THE DYNAMIC STRUCTURE OF A DEEP ESTUARY,
National Oceanic and Atmospheric Administration, Rockville, MD. Office of Marine Pollution Assessment.
M. Devine.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 271-289, March, 1983. 3 Fig, 28 Ref.

Descriptors: *Estuaries, *Boundary layers, Mathematical models, Velocity, Salinity, Stratification, Upwelling, Mixing, River flow, Path of pollutants, Flushing, Dynamics.

A boundary layer formulation for the dynamic structure of a deep estuary is developed. Cross-stream averages are used, but the boundary layer structure is shown to depend on the cross-stream geostrophic constraint. A similarity transformation and a weighted residual method are used to derive an approximate solution for the velocity and salinity structure of the upper layer. This solution indicates that, in the central regime of the estuary, outflow extends through the entire halocline. Inflow takes place in a much less stratified lower layer, and mass exchange between the layers is by upwelling. This structure is modified in the outer regime of the estuary, where mixing between the layers develops, and in the inner regime, where a sharp halocline develops and where the dynamics are dominated by river runoff. The implications of the dynamics for the flushing process and for pollutant movement and dispersion are discussed. (Author's abstract)
W84-01384

STUDIES ON THE BEHAVIOUR OF NUTRIENTS IN THE MANDOVI ESTUARY DURING PREMONSOON,
National Inst. of Oceanography, Panaji (India).
S. N. De Sousa.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 299-308, March, 1983. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Estuaries, *Nutrients, Silicates, Nitrates, Phosphates, Salinity, Mixing, Industrial wastes, Water pollution, India.

Behavior of silicate, nitrate and phosphate in the Mandovi Estuary (India) was studied during the premonsoon season. The study shows that silicate is removed from the water column while nitrate showed an internal source. This nitrate source has been identified as the wash water from an iron ore screening plant which discharges the muddy waste directly into the river. Applying mixing relations, the distribution of this nitrate both up- and downstream of the outfall has been studied. Phosphate showed very low concentrations in the low salinity region; however, its concentration increased slightly towards the higher salinity region. (Author's abstract)
W84-01385

TIDAL EXCHANGE OF NITROGEN AND PHOSPHORUS BETWEEN A MESOHALINE VEGETATED MARSH AND THE SURROUNDING ESTUARY IN THE LOWER CHESAPEAKE BAY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
T. G. Wolaver, J. C. Zieman, R. Wetzel, and K. L. Webb.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 3, p 321-332, March, 1983. 5 Fig, 1 Tab, 24 Ref. R/ER-1.

Descriptors: *Estuaries, *Salt marshes, *Tidal exchange, *Nutrient cycling, Nitrites, Phosphorus, Nitrogen, Ammonium, Fluctuations, Seasonal variation, Wave action, Particulates, Solute transport, Sediment transport, Vegetation, Chesapeake Bay.

A 22-month study was conducted to determine the exchange of nitrogen and phosphorus between a mesohaline vegetated marsh in the Carter's Creek area of Virginia and the surrounding estuary, focusing on the role of the vegetated marsh surface in the processing of these constituents. On an annual basis there was a removal of NH4(+), PO4(3-), NO3(-), dissolved organic nitrogen, dissolved organic phosphorus, particulate nitrogen and particulate phosphorus from the tidal water as it resided on the vegetated marsh. Only nitrite was transported from the marsh to the estuary. Most of the nitrogen and phosphorus species showed distinct seasonal trends with respect to the direction of transport except nitrate and orthophosphate. The ammonium flux data indicates that this nutrient was removed from the inundating water during late spring and fall, with a slight release of this constituent into the tidal water during the late summer. The transport of nitrite was from the estuary to the marsh for most of the year except during the summer. The largest re
particulate nitrogen and phosphorus from
water occurred during the summer mon
the turbidity of the tidal water was high
cially when wave scouring of the mudfla
material into the water column. A loss o
late nitrogen from the marsh to the est
evident during the fall and winter. (Aut
stract)
W84-01386

**VERTICAL MIXING AT THE HEAD
LAURENTIAN CHANNEL,**
McGill Univ., Montreal (Quebec). Inst. o
ography.
R. G. Ingram.
Estuarine, Coastal and Shelf Science, Vol
3, p 333-338, March, 1983. 2 Fig, 13 Ref.

Descriptors: *Estuaries, *Mixing, *Tidal
Water temperature, Salinity, Velocity, M
Primary productivity, Turbidity, Fluc
Water circulation, Density, Laurentian

Temperature, salinity and velocity profil
over a 5-day period in the St. Lawrence E
the head of the Laurentian Channel are
describe the semidiurnal tidal period isop
cillations occurring in this region. Th
show a regular occurrence of large vertica
tions of the density field with semidiurnal
ity. They also show the presence of a sma
tude quarter-diurnal variability and an i
low frequency contribution which coul
analyzed because of the short record len
observed variation in the degree of vertica
over the tidal cycle is used to support the
of nutrification of the estuarine surface wa
suggests an explanation for the quarte
variability of primary production in this
The influence of mixing processes occurri
head of the Laurentian Channel act to mo
characteristics of the lower estuary surfac
by the vertical flux of subsurface waters
sampling site. The findings suggest a sen
infusion of nutrients into the euphotic zo
quarter-diurnal variability in stability co
which may lead to a response in primary
tivity as growth is much reduced/increase
periods of increased/decreased tur
(Moore-IVI)
W84-01387

**WATER AND ORGANIC CARBON F
FROM AN IRREGULARLY FLO
BRACKISH MARSH ON THE UPPER
COAST, U.S.A.,**
Rice Univ., Houston, TX. Dept. of Biology
R. B. Borey, P. A. Harcombe, and F. M. Fi
Estuarine, Coastal and Shelf Science, Vol.
4, p 379-402, April, 1983. 14 Fig, 3 Tab,
OCE 75-19633, DES 75-17184.

Descriptors: *Coastal marshes, *Organic
Water level fluctuations, Flow rate, F
Rainfall, Tidal floods, Seston, Vegetatio
ment transport, Solute transport, Primary
tivity, Detritus, Fluctuations, Brackish
Texas.

Water flows, concentrations of total (TO
solved (DOC), and particulate (POC)
carbon and seston were monitored for
periods in the single creek draining a 270-h
tina patens - Distichlis spicata marsh on th
Texas coast. Rainfall, creek water flows, an
levels in the creek and on the marsh wer
ured by recording instruments. Rainfall ac
for most marsh flooding, and water outfl
significantly correlated with both rainf
marsh water level. Creek flows were predo
ly outward because microtopographic featu
dense vegetation restricted overmarsh wate
and thereby reduced tidal flooding while ex
the time of precipitation runoff. Concentra
organic carbon in water leaving the mars
highest in spring and summer and average
21.41 and 3.35 mg/l of TOC, DOC and
respectively. These were 9.34, 9.93 and 0.0
respectively, higher than bay water. Mos
was 0.3-28 micro m in diameter. Seston

leaving the marsh was 95% amorphous
the rest was plankton, grass particles and
lets. Loss of organic carbon was directly
d with net water flux, and thus rainfall
d for most carbon loss. Net carbon loss
196 kg TOC, 150 kg DOC and 32 kg
day. Net annual loss was 2.4-5.5% of net
imary productivity (NAPP), or 21.55-
TOC/sq m/yr. Export from this marsh
in the range found for other marshes and
collectively indicate that coastal marshes
osing as much organic carbon as has been
l by indirect measurements. The discrep-
ween potential and realized export is ex-
y the fact that export is not a simple
of excess detritus by tidal action but is
nplicated process mediated by the interac-
dditional factors such as rainfall, vegeta-
cture, microtopographic variation and de-
ion, which can serve to reduce the
nd quality of NAPP exported. (Author's

89

DISCHARGE CONTROLS PHYTO-
ON DYNAMICS IN THE NORTHERN
NCISCO BAY ESTUARY,
al Survey, Menlo Park, CA.
ern, A. E. Alpine, B. E. Cole, R. L. J.
d J. F. Arthur.
, Coastal and Shelf Science, Vol. 16, No.
429, April, 1983. 8 Fig, 2 Tab, 46 Ref.

ors: *Estuarine environment, *Phyto-
*River flow, Drought, Flow discharge,
Population dynamics, Mixing, Suspended
, Turbidity, San Francisco Bay.

nkton dynamics in the upper reach of the
San Francisco Bay estuary are usually
ized by low biomass dominated by micro-
or freshwater diatoms in winter, and
mass dominated by neritic diatoms in
During two successive years of very low
charge (the drought of 1976-1977), the
liatom bloom was absent. This is consist-
the hypothesis that formation of the
opulation maximum is a consequence of
physical mechanisms that create local
f suspended sediments in partially-mixed
density-selective retention of particles
estuarine circulation cell. Because the
turbid, calculated phytoplankton growth
small in the central deep channel but are
large in lateral shallow embayments
ht limitation is less severe. When river
falls within a critical range (100-350 cu
positions the suspended particulate maxi-
cent to the productive shallow bays, the
n of neritic diatoms increases. However,
riods of high discharge (winter) or during
f very low discharge (drought), the sus-
articulate maximum is less well-defined
coupled (positioned downstream or up-
om the shallow bays of the upper estu-
he population of neritic diatoms declines.
e biomass and community composition of
kton in this estuary are controlled by
harge. (Author's abstract)
1

EMOVAL OF DISSOLVED HUMIC
URING ESTUARINE MIXING,
Univ., Lewes. Coll. of Marine Studies.
Coastal and Shelf Science, Vol. 16, No.
440, April, 1983. 5 Fig, 2 Tab, 29 Ref.
9835.

rs: *Humic acids, *Estuaries, Mixing, Or-
ion, Solute transport, Salinity.

method for the determination of dis-
mic acid based on carbon analysis is
This method was used to measure the
n of dissolved humic acids in seven
ain estuaries located in the middle-Atlan-
States. Results indicate that 100% of the
humic acid was removed during estuar-
g, although concurrent measurements of
organic carbon showed either produc-

tion or conservative behavior in regions of the estuary where humic acid removal was observed. It is apparent from these observations that removal of dissolved humic acid is a minor part of the estuarine transport of dissolved organic carbon. Laboratory experiments carried out by mixing river water with sea water demonstrated that salt-induced removal of dissolved humic acid was insignificant in two of three estuaries studied. These results suggest in situ removal of dissolved humic acid may not be universally caused by increasing estuarine salinity. (Author's abstract)
W84-01392

DISTRIBUTION OF SOME METALLIC ELEMENTS IN EELGRASS (ZOSTERA MARINA L.) AND SEDIMENT IN THE LIMFJORD, DENMARK,
Aarhus Univ. (Denmark). Botanical Inst.
H. Brix, and J. E. Lyngby.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 4, p 455-467, April, 1983. 8 Fig, 3 Tab, 34 Ref.

Descriptors: *Submerged plants, *Sea grasses, *Metals, Sediments, Calcium, Cadmium, Copper, Iron, Potassium, Magnesium, Manganese, Sodium, Lead, Zinc, Mineral cycling, Brackish water, Limfjord, Denmark.

The distribution of Ca, Cd, Cu, Fe, K, Mg, Mn, Na, Pb and Zn in different parts of eelgrass (Zostera marina L.) and sediment (0-25 cm depth) collected at three locations in the Limfjord, Denmark, were investigated. Eelgrass plants were divided into roots, rhizomes, stems and leaves according to age, and the metal content in each fraction was determined. The distribution pattern of the metals could be divided into separate groups according to the following criteria: (i) the age-dependent distribution pattern of the metals in the leaves (the concentrations of Ca, Cd, Fe, Mg, Mn, Na, Pb and Zn increased with the age of the leaves; the concentrations of Cu and K decreased with age); (ii) the concentration level of the metals in the roots compared to that in the rhizomes (Ca, Cd, Cu, Fe, Mn, Pb and Zn concentrations were highest in the roots; K, Mg and Na concentrations were highest in rhizomes); (iii) the concentration level of the metals in the 'stem' -fraction compared to that in the youngest leaf (the concentration of Fe, K, Mg, Na and Pb were highest in the 'stem' -fraction; the concentrations of Ca, Cd, Mn and Zn were highest in the youngest leaf). The distribution pattern of the metals are discussed, especially in relation to the gross morphology of eelgrass. Finally, the relatively large quantity of metals tied up in the eelgrass biomass at the three localities indicated that the eelgrass beds most likely exerted a significant role in the metal cycling in the Limfjord. (Author's abstract)
W84-01393

ON THE PREDICTABILITY OF THE 137CS DISTRIBUTION IN THE SEVERN ESTUARY,
Washington Univ., Seattle. School of Oceanography.
M. Rattray, Jr., and R. J. Uncles.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 5, p 475-487, May, 1983. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Estuaries, *Water circulation, Dispersion, Mathematical models, Salinity, Stratification, Runoff, Radioactive tracers, Cesium, Stokes drift, Severn Estuary.

The observed distribution of Cs137 resulting from known sources in the Severn Estuary permits the testing of simple predictive models for the one-dimensional distribution of non-conservative substances in an estuary. These models either use a known distribution of salinity to infer corresponding ones for other substances, or else directly solve mass balance equations utilizing previously determined dispersion coefficients. Both methods are shown to provide results comparing favorably with observations. Stokes drift plays an important role in the circulation of the Severn. A modified densimetric Froude number, including this drift, is therefore used to estimate the circulation and stratification of the estuary. A new equation is used for calculating the Cs137 distribution from the observed salinity distribution. It generalizes previous formulations to permit variation of the net runoff with position along the estuary. (Author's abstract)
W84-01394

THE TRANSPORT OF BACTERIA IN THE SEDIMENTS OF A TEMPERATE MARSH,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
P. A. Rublee, S. M. Merkel, and M. A. Faust.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 5, p 501-509, May, 1983. 4 Fig, 1 Tab, 17 Ref. DEB 7911563.

Descriptors: *Bacteria, *Salt marshes, Sediment transport, Estuaries, Interstitial water, Tidewater, Biomass, Particulates, Organic material, Marshes.

The number of bacteria in sediments, interstitial water and overlying tidal water of an oligohaline marsh system are about 109, 106 and 106 cells/cu cm, respectively. Average cell size in the overlying water (about 0.06 cu micro m), is much smaller than that in sediments and interstitial water (about 0.18 cu micro m). Most bacteria cells in sediments are bound to sediment particles and less than 1% of the cells were displaced by percolating water through sediment columns. Concentration of bacteria in flooding tidal waters is generally higher than that in ebbing waters. Movement of bacterial biomass does not appear to be a significant mechanism of particulate organic transport in marsh sediments and marsh sediments do not appear to be a source of suspended bacteria for estuaries. (Author's abstract)
W84-01395

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

EVALUATION OF THE HYDRODYNAMIC DISPERSION COEFFICIENT USING LEACHED FRACTION EQUATIONS,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 2G.
W84-01232

MATHEMATICAL MODEL FOR COMPOSITE MEMBRANES FOR REVERSE OSMOSIS,
National Taiwan Univ., Taipei. Dept. of Chemical Engineering.
C.-C. Lin, and M.-K. Chiang.
Separation Science and Technology, Vol. 18, No. 3, p 229-237, 1983. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Reverse osmosis, *Membrane processes, Desalination, Mathematical models, Simulation, Membranes, Permeability, Flow.

A mathematical model is developed to describe the transport phenomena in reverse osmosis desalination with composite membranes, which consist of two components having different value of A and B, where A is a membrane constant for water flow and B is a solute permeation constant. The composite membrane is composed of a dispersed phase (Component I) and a matrix phase (Component II). It is found possible to fabricate a high performance membrane by casting a film composed of a small particle size of Component II with a large value of A and a very thin Component I with a small value of B, in the practical separation technique. (Moore-IVI)
W84-01306

3B. Water Yield Improvement

USING HISTORICAL COMPARISONS IN EVALUATING CLOUD SEEDING OPERATIONS,

Rochester Univ., NY. Dept. of Statistics.
K. R. Gabriel, and D. Petrondas.
Journal of Climate and Applied Meteorology, Vol. 22, No. 4, p. 626-631, April, 1983. 8 Tab, 6 Ref.

Descriptors: *Cloud seeding, *Precipitation, Statistical methods, Simulation, Weather modification, History.

Cloud seeding operations are often evaluated by comparing precipitation during operations with records of previous 'historical' precipitation. Extensive worldwide precipitation records are used to examine whether the usual statistical techniques may be validly applied to comparisons of precipitation in successive years, as is done in the evaluations of cloud seeding. To study the operating characteristics of tests of significance, records of annual precipitation for successive years at a number of stations are divided into two periods, the first of which is regarded as 'historical' and the second as ' operational.' In this way, a pseudo-experiment can be simulated in which there is no effect of seeding. It is concluded that the chance of finding a significant seeding effect in the absence of seeding is usually well above the nominal significance level used. It is therefore recommend that P-values from such operational/historical comparisons be treated very cautiously, possibly by multiplying them by a suitable factor, e.g., a 5% significant result of such a comparison should really be regarded as more nearly as 10% significant. (Moore-IVI)
W84-01169

3C. Use Of Water Of Impaired Quality

CARBONATE DEPOSITS IN VACUUM PUMPS OF O'NEILL PUMPING PLANT, CALIFORNIA,
Water and Power Resources Service, Sacramento, CA.
N. P. Prokopovich, and E. G. Robles, Jr.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 2, p 197-203, May 1983. 9 Fig, 1 Tab, 3 Ref.

Descriptors: *Pumps, *Calcium carbonate, *Scaling, Cooling water, Carbon dioxide, Vacuum pumps, Reservoir operations, California.

The O'Neil Pumping-(Generating) Plant was designed to pump-lift mostly irrigational water from the Delta-Mendota Canal into O'Neil Forebay Reservoir. After a few months of operation pumping toe drain water to the pumping plant for use as cooling water, a small vacuum pump failed. Inspection of the dismantled pump revealed intense, buff-colored incrustations on its interior surface. The crust was strongly indurated with the steel body of the pump and was usually 0.5 mm thick, and locally 2-3 mm thick. Chemical tests of the scrapings indicate their composition to be of calcium carbonate with traces of limonitic pigment. Toe drain water is extremely rich in carbon dioxide and bicarbonate, and the concentration of both drops notably in the discharged cooling water. The original source of O'Neill water is the relatively soft, but highly turbid waters of the Sacramento-San Joaquin Delta. During storage in O'Neill and San Luis Reservoirs (both of which are underlain by calcareous deposits) the deltaic water dissolves variable amounts of soluble salts, particularly bicarbonates, and the decay of aquatic vegetation in the reservoirs creates carbon dioxide. This hard but clean water enters the vacuum pumps and, under vacuum conditions, releases its carbon dioxide, breaking soluble bicarbonates into carbon dioxide, water, and insoluble carbonate which is deposited on the pumps' interior surfaces. (Moore-IVI)
W84-01059

A CELL TO STUDY CORROSION OF MATERIALS IN THE WATER SUPPLY INDUSTRY,
Surrey Univ., Guildford (England). Dept. of Metallurgy and Materials Technology.
For primary bibliographic entry see Field 8G.
W84-01072

SALINE WATER USE PROSPECTS: COLORADO RIVER,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
M. B. Bessler.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 221-231, June, 1983. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Saline water, *Alternative water use, Slurries, *Colorado River, River basin development, Water resources development, Economic aspects, Energy, Legal aspects.

Cost-effectiveness estimates are discussed for various alternative uses for saline water in the Colorado River Basin. Local saline water use, in areas less than 100 mi distant, for energy production looks promising, but cost-effectiveness is very sensitive to specific site conditions. In order to encourage use of saline water vs freshwater, most utilities need regulatory or financial incentives. The use of saline water for coal slurry transport appears to offer significant potential for joint use savings and reduction in the costs of salinity control. Legal issues and concerns raised about procedures for acquiring diversion rights, allocation of waste saline water among state and federal interests, and transfer of saline water across state boundaries are problems which must be addressed by the Basin states. The institutional arrangements for implementing the options lend themselves to a unique partnership between the federal government and industry. Through the federal salinity control effort, the use of desalting plants and lined evaporation ponds for ultimate disposal would require large monetary investments both in up front construction costs and in long term maintenance. If the private sector were to activate some of these alternative uses for saline water there would also be monetary investments needed. A part of the government capital, focused toward a joint venture with energy related industries, could mean decreased monetary investments for both government and industry and each would reap the rewards. A new bill to amend the 1974 Colorado River Salinity Control Act (Public Law 93-320) has been introduced recently which would permit such joint ventures to take place. (Baker-IVI)
W84-01152

RE-CYCLING OF INDUSTRIAL COOLING WATER,
G. B. Hill.
Water and Waste Treatment Journal, Vol. 26, No. 5, p 56-57, May, 1983. 2 Fig.

Descriptors: *Water cooling, *Water reuse, Recirculated water, Design criteria, Cooling ponds, Cooling towers, Refrigeration.

In the light of the growing costs and restrictions imposed upon industrial usage of mains water, together with the vulnerabilities exposed by supply failures, there are increasing requests for recirculatory cooling water systems. The simplest method for cooling water is the cooling pond. A spray pond extends the principle a little further, but both methods suffer from water contamination and are only suitable for cooling water received at higher temperatures. Another simple method is the atmospheric cooling frame where water is sprayed down a louvered shell through which the wind blows, mixing with the water and cooling it. Performance is dependent on weather and the system suffers from water carry-over. Chimney natural draft cooling towers have warm water released at the top of the tower falling over the large area of packing below, while air flowing up through the tower by convection cools the water. Mechanical draft cooling towers are almost independent of atmospheric conditions, other than the ambient wet bulb temperature. Air blast coolers pass heated water through tubes over which cooling air is blown by an axial flow fan. Heat transfer is assisted by fitting fins or wire on the tube outer surface. Water chillers employ the basic mechanical compression refrigeration systems of reciprocating, centrifugal or screw design. Adsorption systems are rarely used. The water cooling duty related to the water flow rate and temperature rise when passing through the plant, determines the size of equipment needed. (Baker-III)
W84-01259

ECONOMICS OF IRRIGATION MIXING WITHIN A FARM FRAMEWO
California Univ., Riverside. Dept. of Soi
vironmental Sciences.
E. Feinerman, and D. Yaron.
Water Resources Research, Vol. 19, No. 345, April, 1983. 6 Tab, 19 Ref.

Descriptors: *Saline water, *Irrigatio
Mathematical models, Decision making,
aspects, Salinity, Crop selection, Rainfa
soils, Israel.

Linear programming models, determinis
short run and stochastic (random rainfa
long run, aimed at guiding annual decisio
with regard to crop mix and saline irrigat
mixing from various sources within a far
work, are presented. The short-run model
rates the physical, biological, and econo
tionships involved in one endogenous sy
enables an in-depth analysis of them but
to a single year. The long-run model con
effects of the short-run decisions on the f
several relationships are incorporated exo
The short-run model's results are utilize
determination of some of these predeterm
tionships. The models are applied to a
farm situation in southern Israel. The re
vide priorities in the allocation of water
plots of varying salinity levels and empi
mates of the shadow prices and the rates
tution between the limited resources.
abstract)
W84-01360

3D. Conservation In Domesti Municipal Use

REGIONAL VERSUS LOCAL WATER PLANNING,
Corps of Engineers, Baltimore, MD.
District.
For primary bibliographic entry see Field
W84-01141

WELLESLEY'S WATER PROGRAM NING; DEMAND STRATEGY,
Massachusetts Dept. of Public Works,
Hills.
For primary bibliographic entry see F
W84-01156

3F. Conservation In Agricultu

WATER ALLOCATION CONFLICTS CANADIAN PRAIRIES,
Manitoba Univ., Winnipeg. Dept. of Civ
neering.
For primary bibliographic entry see Fi
W84-01145

INTERRELATIONSHIPS OF IRRIG UNIFORMITY TERMS,
Arizona Univ., Tucson. Dept. of Soils, W
Engineering.
A. W. Warrick.
Journal of Irrigation and Drainage Engi
Vol. 109, No. 3, p 317-332, September, 198
2 Tab, 20 Ref.

Descriptors: *Irrigation efficiency, *Infi
*Uniformity coefficient, Soil water, Va
Surface irrigation, Level basin irrigation, S
methods.

Irrigation uniformities are examined for
sumed statistical distributions of depth
infiltrated. Christiansen's uniformity (UC)
lower quarter distribution uniformity (DU
lated analytially to the coefficient of va
(CV) in each case. The distributions chose

l, log normal, uniform, a specialized power, nd gamma distributions. In all cases studied, V values of less than 25%, approximate forms : and DU were found valid. Three examples ven using the specialized power and beta ution. It is demonstrated that the specialized function is exact for level basin irrigation led the surface water advance is proportional ower of time and the intake rate everywhere proached a constant value for recession. or's abstract)
01147

IGHT ANALYSIS AND SOIL MOISTURE ICTION,
noessische Technische Hochschule, Zurich erland). Versuchsanstalt fuer Wasserbau, logie und Glaziologie.
Smart.
l of Irrigation and Drainage Engineering, 09, No. 2, p 251-261, June, 1983. 6 Fig, 1 4 Ref.

ptors: *Soil water, *Drought, *Irrigation re-ents, Mathematical models, Rainfall, Evapo- Pastures, Water demand, New Zealand, Island, Canterbury Plain.

e alluvial Canterbury Plain in the South of New Zealand, short-term variation in is considerable. On most irrigated farms, on is determined by a roster allocation or a demand system. Both roster and d systems require a technique for estimating rrent soil moisture status if they are to be t in terms of water usage. Soil moisture are predicted by a simple, conceptual ac-g model run with daily rainfall and evapo-inputs. Model output is used to illustrate al statistical procedures for drought fre-, duration and severity. Frequency is de-y the probability of a drought starting in a nonth, duration is determined by run-length s and severity is given in terms of soil re level. Predicted moisture contents for the) mm (4 in.) of soil below ryegrass pasture tistically similar to actual moisture levels ed in Canterbury, New Zealand. For this n. accurate rainfall forecasts could substan-educe irrigation water demands. (Moore-

149

IUM MOISTURE CONTENT FOR COM-NG SOILS: ONE-POINT METHOD,
on Research Inst., Lahore (Pakistan).
imary bibliographic entry see Field 2G.
151

LOSS AT SOIL-DRAIN ENVELOPE IN-CES,
Carolina State Univ. at Raleigh. Dept. of cal and Agricultural Engineering.
mary bibliographic entry see Field 4A.
153

NT OF PROFILE WATER IN EARLY G RESULTING FROM INCREASED LE WATER IN FALL,
Agricultural Experiment Station, Manhat-apotranspiration Lab.
one, C. G. Carlson, T. L. Hanson, R. E. r., and P. Gallagher.
ence Society of America Journal, Vol. 47, o 305-309, March-April, 1983. 4 Fig, 1 Tab,

tors: *Irrigation efficiency, *Fall irrigation, ter, Field capacity, Corn, Alfalfa, Wheat, torage, Profile water.

d availability of fuel, water supplies, and re creating interest in extending irrigation e dormant season. The amount of profile n early spring that resulted from increased water in fall was assessed at three locations oil, climate, and limited irrigation resources fall irrigation has potential as a manage-ractice. Soils were Ulysses silt loam (fine-silty, mixed, mesic Aridic Haplustoll), Amsterdam silty clay loam (fine-silty, mixed Typic Cryoboroll), and Great Bend silt loam (fine-silty, mixed Udic Haploboroll) at Tribune, Kansas, Bozeman, Montana, and Redfield, South Dakota, respectively. Crops were corn and winter wheat at Tribune; alfalfa and spring wheat at Bozeman; and alfalfa, corn, spring wheat, and winter wheat at Redfield. Differences in crop growth patterns and irrigation regimes provided a broad range of fall soil water contents at each location. Profile soil water content was sampled gravimetrically at Tribune and by neutron attenuation at Bozeman and Redfield no earlier than 10 d after fall irrigation and in early spring. By multiple regression analysis, it was established that profile water content change rate during winter (profile water at early-spring sampling minus profile water at fall sampling divided by the number of days) decreased and as available soil water in fall increased. The amounts of profile water in early spring resulting from 10 mm of additional fall profile water, calculated by using the long-term precipitation mean for 22 December through 31 March at each location (0.44, 0.54, and 0.52 mm/d for Tribune, Bozeman, and Redfield, respectively) were: 8.6, 6.8, and 5.0 mm at Tribune; 8.5, 7.5, and 6.6 mm at Bozeman; and 8.2, 7.0, and 5.8 mm at Redfield for available soil water values in fall of 30, 50, and 70%, respectively. The data and calculations show fall irrigation to be an inefficient practice for many situations, even where the antecedent profile water content is well below the 'field capacity' value. (Moore-IVI)
W84-01163

STATISTICAL ANALYSIS OF LINE-SOURCE SPRINKLER EXPERIMENTS AND OTHER NONRANDOMIZED EXPERIMENTS USING MULTIVARIATE METHODS,
Kansas State Univ., Manhattan. Dept. of Statistics.
D. E. Johnson, U. N. Chaudhuri, and E. T. Kanemasu.
Soil Science Society of America Journal, Vol. 47, No. 2, p 309-312, March-April, 1983. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Statistical analysis, *Sprinkler irrigation, Crop yield, Multivariate analysis, Mathematical studies.

The line-source sprinkler system provides a continuous variable soil water gradient away from a water source. The system can be used effectively to study the effects of various levels of water applied on crops, and minimizes the amount of land required for such experiments. A recent paper suggested that there was no statistical test available for comparing the effects of irrigation level on yield because irrigation levels are often applied systematically without randomization. This paper shows how multivariate methods can be used to obtain an appropriate statistical test. The method can also be used for many other nonrandomized experiments. One such experiment occurs when readings on the same experimental unit are recorded at several different time periods. Another occurs when measurements are made on several different parts of the same plant, e.g. stem, leaf, etc. The methods provide tests for equal cultivar effects; irrigation effects, and also cultivar X irrigation level interaction. (Moore-IVI)
W84-01187

HEAT REJECTION SYSTEMS: MEETING COSTS, DEMANDS AND REGULATORY REQUIREMENTS,
R. C. Rittenhouse.
Power Engineering, Vol. 87, No. 6, p 46-54, June, 1983. 6 Fig, 4 Tab.

Descriptors: *Cooling towers, *Water cooling, Cooling ponds, Powerplants, Water reuse, Wastewater treatment, Chlorination, Water management.

The heat rejection system in a power plant can offer cost savings if care is exercised in design, operation and maintenance, and if the developing need to upgrade is met with a timely response. Cooling towers may be needed for powerplants in the future because of: tightening regulations for once-through cooling; real estate and water shortages; environmental impact, and the large amounts of cooling surface which may be needed. Use of a cooling tower vs cooling lakes is considered. The potential advantages of multiple use of cooling lakes should be considered during the evaluation of types of cooling systems to be chosen for a site. Maintenance and upgrading of tower operations are important for controlling costs. Environmental regulations limiting the concentration of chlorine discharges make it imperative that utility staff people monitor the behavior of the biocide to optimize its capabilities while controlling its discharge. Water conservation or the lack of water in arid regions are the primary reasons for the development of wet/dry and dry cooling tower technology. (Baker-IVI)
W84-01236

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOOD ROUTING ON A SMALL COMPUTER,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W84-01089

CONSERVATISM OF PROBABLE MAXIMUM FLOOD ESTIMATES,
Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 8B.
W84-01097

ESTIMATING UNIT HYDROGRAPH PEAK RATE FACTORS,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W84-01150

HEAD LOSS AT SOIL-DRAIN ENVELOPE INTERFACES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
D. W. Miller, and L. S. Willardson.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 221-220, June, 1983. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Head loss, *Hydraulic gradient, Hydraulic permeability, Drainage practices, Permeability, Interfaces, Laminar flow, Fluid mechanics, Earth-water interfaces, Soil physical properties.

A two-stage upward flow permeameter was designed which allowed a screen or filter fabric disk to be inserted in the center of a soil column as well as at the outlet of the permeameter. The interface was studied under two conditions: one with water passing from a porous medium through an interface and back into the same medium, and a second with water passing from a porous medium through an interface and into water ponded above the interface. A fundamental difference was found between the head loss across the two interfaces. The difference in hydraulic gradients at internal and exit interfaces was attributed to the simultaneous action of two processes: the physical restructuring of the interfacial zone as viscous drag caused soil particles or sand grains to bridge over or plug pores in the interface; and a second process, which seems to be a function of the changing ratio of viscous and inertial forces occurring as water passes through exit interfaces. The geometry of the flow paths changes dramatically during this passage and this change in turn alters the distribution of viscous shear and inertial forces acting between the water and the boundaries of individual flow paths. Head loss in soil was greater at exit interfaces than would be predicted using laminar flow theory. Water leaving the soil and entering a drain

or a very permeable drain envelope demonstrates an excess energy loss. Artificial internal interfaces in the soil do not show the same head loss as exit interfaces. Inertial energy losses seem to explain the difference in the head losses measured for the two types of interfaces. The findings suggest that high gradients at exit interface of a porous medium mean that hydraulic failure gradients may occur under flow conditions that would theoretically be stable. The effect of the large exit gradient could also reduce the apparent permeability of soil samples where only inflow and outflow heads are measured. Piezometers measuring internal hydraulic gradients in soil samples should be at least 4 cm away from the exit interface. (Baker-IVI)
W84-01153

4B. Groundwater Management

ISOTOPIC INVESTIGATION OF A NEAR-SURFACE GROUNDWATER SYSTEM,
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
For primary bibliographic entry see Field 2G.
W84-01102

HP41C AND T159 PROGRAMS FOR ANISOTROPIC CONFINED AQUIFERS,
Kansas Univ., Lawrence.
For primary bibliographic entry see Field 2F.
W84-01115

GROUND-WATER MODELING WITH AN INTERACTIVE COMPUTER,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W84-01116

NOORDBERGUM EFFECT AND CHARACTERIZATION OF AQUITARDS AT THE RIO MAIOR MINING PROJECT,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 2F.
W84-01117

HYDROGEOLOGY OF PIPELINE CANYON, NEAR GALLUP, NEW MEXICO,
New Mexico Health and Environment Dept., Santa Fe. Environmental Improvement Div.
For primary bibliographic entry see Field 2F.
W84-01118

DETERMINING HYDRAULIC CONDUCTIVITY DISTRIBUTIONS IN A MOUNTAINOUS AREA USING MATHEMATICAL MODELING,
Campbell Geoscience Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 2F.
W84-01119

SALT-WATER INTRUSION IN THE NILE DELTA,
A.-A. I. Kashef.
Ground Water, Vol. 21, No. 2, p 160-167, March-April, 1983. 4 Fig.

Descriptors: *Saline water intrusion, *Groundwater management, *Groundwater potential, Egypt, Nile River, Groundwater recharge, Irrigation water, Groundwater irrigation, Geohydrology, Land reclamation, Infiltration, Seepage.

Egypt is presently involved in a comprehensive program of land reclamation. Surface water has already been exhausted in meeting the urgent needs of agricultural expansion. Ground-water development has priority over increasing irrigation efficiency (which would take a longer time). A review of the recent investigations of the groundwater resources in the Delta aquifer is given, and an attempt is made to determine the extent of intrusion using two unconventional methods based on the available geohydrological data. The case is unique because most of this aquifer is invaded by salt water, and the major portion of its annual ground-water recharge is derived from the direct seepage from the Nile River and the huge net of irrigation canals serving about 3 million acres (approximately 11,561 sq km) of fertile land, as well as the infiltration of excess irrigation water. The annual overall groundwater recharge to the aquifer was estimated as 6.40 cu km/yr. Methods of salt-water control and various techniques of water resources management are discussed. Groundwater development may be started south of potentiometric contour +10 and along the Nile branches (if there is no conflict in water use). North of contour +10, utmost care should be observed regarding high pumping or extensive developments. It is recommended that pilot projects be started to control salt-water intrusion. (Moore-IVI)
W84-01120

HARMONIZING GHYBEN-HERZBERG INTERFACE WITH RIGOROUS SOLUTIONS,
A.-A. I. Kashef.
Ground Water, Vol. 21, No. 2, p 153-159, March-April, 1983. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Saline-freshwater interfaces, *Saline water intrusion, Mathematical studies, Groundwater management, Coastal aquifers, *Ghyben-Herzberg interface, Groundwater movement.

Ground-water management in coastal aquifers is becoming highly complex due to the increase in water demand coupled with the threat of salt-water encroachment. The salt-water/fresh-water interface produced by the natural flow of the aquifer is distorted as a result of ground-water exploitation. During the last four decades, the use of Ghyben-Herzberg (G-H) principle to determine the salt-water/fresh-water interface in coastal aquifers was questioned by many investigators due to the neglect of the water movement. Some of the highly complex solutions which were later introduced are reviewed and compared with the G-H results for a very wide range of parameters. It has been found that the G-H principle is valid for practical purposes and that the differences between location of the interface predicted by the G-H principle and those determined by the rigorous solutions may be less than the differences resulting from small errors in the field records of water levels. For exceptionally high natural velocities and for more precision within the zones very close to the shore, two simple equations derived on the basis of the rigorous solutions are given. Each equation is written in terms of the popular G-H solution with a correction factor added. The results of these equations are tabulated in dimensionless values for practical use. Moreover, the extent and size of the fresh-water lens can be determined from the field records of one or two shallow observation wells. An example is given to clarify the procedure. (Moore-IVI)
W84-01121

BASIN RECHARGE OF PLAYA WATER,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
A. D. Schneider, and O. R. Jones.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 3, p 309-316, September, 1983. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Recharge basins, *Artificial recharge, *Ogallala aquifer, *Playas, Storm runoff, Groundwater recharge, Permeability, Turbidity, *Texas, High Plains.

A 0.20-ha (0.5-acre) recharge basin was tested for conserving storm runoff that collected in a 16-ha (40-acre) playa in the Southern High Plains, southwest of Amarillo, Texas. The basin was constructed by removing 1.2 m (4 ft) of the slowly permeable Pullman soil to expose a 0.3 (1-ft) thick caliche layer overlying permeable sediments. Turbid water was pumped from the playa to the basin during eight tests over a 7-yr interval. Average recharge rate during 187 days of flooding was 0.373 m/d (1.22 ft/day). After three recharge tests during the first year, no maintenance was done to the basin bottom. Research showed that recharge basins could be an effective technique for partial
ishing the depleted Ogallala Aquifer. (M
W84-01148

**THE DECLINE AND PARTIAL RECOV
GROUNDWATER LEVELS BELOW L**
Institute of Hydrology, Wallingford (Eng
T. J. Marsh, and P. A. Davies.
Proceedings of the Institution of Civil
ing, Vol. 74, p 263-276, May, 1983. 14 Fi

Descriptors: *Groundwater levels, *Gro
recession, England, Confined aquifer
water intrusion, Boreholes, Groundwat
tion, Subsidence, Groundwater managem
nomic aspects, Licensing.

Until recently groundwater levels in the
Lower London Tertiary deposits below
(England) have been declining in re
heavy exploitation of the groundwater
By 1950, groundwater levels stood 20
OD throughout most of the confined aq
depletion in groundwater resources ha
quences extending beyond the water supp
try, including the failure of supply boreh
water intrusion, ground settlement, a red
river flows, and an increasing frequency
of springs. The growing appreciation
problems by water management together
economic decline following the 1939-194
borehole licensing provisions brought
stop to further aquifer development. Tota
water abstraction from the confined
reached a peak of 80,000,000 cu m/ a betw
and 1940; yield had fallen back to 62,000,0
a by 1965. During the past 20 years,
recovery in groundwater levels has tak
but the recovery should be regarded a
(Moore-IVI)
W84-01249

**A REVIEW OF DISTRIBUTED PARA
GROUNDWATER MANAGEMENT
ING METHODS,**
Geological Survey, Menlo Park, CA.
S. M. Gorelick.
Water Resources Research, Vol. 19, No.
319, April, 1983. 1 Fig, 102 Ref.

Descriptors: *Groundwater managemen
agement models, Model studies, Grou
movement, Solute transport, Water a
Policy making, Water quality, Undergrou
disposal, Water quality management, Grou
hydraulics, Economic aspects, Political asp

Models which solve the governing grou
flow or solute transport equations in co
with optimization techniques, such as li
quadratic programming, are powerful aqu
agement tools. Groundwater managemen
fall in two general categories: hydraulics
evaluation and water allocation. Groundw
draulic management models enable the de
tion of optimal locations and pumping
numerous wells under a variety of re
placed upon local drawdown, hydraulic g
and water production targets. Groundwat
evaluation and allocation models can be
study the influence upon regional groundw
of institutional policies such as taxes and
Furthermore, fairly complex groundwate
water allocation problems can be handl
system decomposition and multilevel optim
Experience from the few real world applic
groundwater optimization-management te
is summarized. Classified separately are
for groundwater quality management aime
timal waste disposal in the subsurface. This
cation is composed of steady state and
management models that determine disp
terns in such a way that water quality is p
at supply locations. Classes of research
from the literature are groundwater quali
agement models involving nonlinear co
models which join groundwater hydrau
quality simulations with political-econom
agement considerations, and management
that include parameter uncertainty. (Auth
stract)
W84-01359

ffects On Water Of
's Non-Water
vities

VARIABLES FROM POLLUTION
OL,
te Univ., Ames. Center for Agricultural
Development.
ines, Jr., and E. O. Heady.
f Environmental Quality, Vol. 12, No. 2,
, April-June, 1983. 7 Tab, 8 Ref.

ors: *Water pollution control, *Nonpoint
sources, *Soil management, *Farms, Soil
Public policy, Taxes, Economic aspects,
ects.

e level of pollution from one farm cannot
y measured or estimated, environmental
ay be difficult to formulate and enforce.
situation, a policy approach is suggested,
ocuses on variables other than direct
pollution. The use of proxy variables is
in an analysis of alternative policies for
g agricultural soil loss in the United
n interregional programming model of
culture is used to analyze and compare
variable approach to direct limits and
gross soil loss, with soil management
employed as proxy variables. In achiev-
ed soil loss reductions, the soil manage-
ctice policy would be less costly to soci-
direct limit of 12.5 t/ha of soil loss, but a
ch t of soil loss would be the least costly
assuming that soil loss could be easily
. (Author's abstract)
8

USE, FLOODS, AND CHANNEL
S: UPPER MIDDLE FORK WILLAM-
VER, OREGON (1936-1980),
tate Univ., Corvallis. School of Forestry.
ns, and R. L. Beschta.
sources Research, Vol. 19, No. 2, p 463-
, 1983. 5 Fig, 2 Tab, 28 Ref.

rs: *Land use, *Flood damage, *Channel
gy, Landslides, Peak flows, Precipitation,
Road construction, Clear-cutting, Math-
models, Forest watersheds, Willamette
egon.

ds and channel characteristics from 1936
ere evaluated for the Middle Fork Wil-
iver, which drains a 668-sq km forested
in the Cascade Mountains of western
An inventory of aerial photographs from
972 shows that landslides associated with
in clearcuts were 27 and 23 times more
respectively, than in forested areas. Nu-
ndslides unloaded sediments directly into
age system; most landslides appear to
initiated during a large flood (return
eater than or equal to 100 years) of De-
2, 1964. Analysis of precipitation and
s (greater than 100 sq m/s) from 1958 to
eans of power function models suggests
f increasing flows as timber harvesting
building expanded in the basin. Changes
pattern, documented from aerial photo-
ow major increases in channel width
to 1967 and a trend of decreasing width
to 1980. During summer low flows in
1980, 65 cross sections of the channel
eyed to provide detailed measurements
channel conditions. Channel widths of
ne aggraded reaches were significantly
pha=0.05) than those for nonaggraded
Author's abstract)
5

tershed Protection

IRONMENTAL MONITORING PRO-
OR THE WATERSHED OF THE
OND AND RICHARDI RESERVOIRS,
Webster Engineering Corp., Boston,

For primary bibliographic entry see Field 6B.
W84-01158

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

STUDIES ON THE ANODIC STRIPPING VOLTAMMETRY OF LEAD IN POLLUTED ESTUARINE WATERS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica.
S. A. Acebal, and A. D. Rebello.
Analytica Chimica Acta, Vol. 148, p 71-78, April 1983. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Lead, *Seawater, *Copper, *Voltammetry, Estuarine environment, *Pollutant identification, *Brazil, Guanabara Bay.

Lead was determined in the polluted tropical waters of Guanabara Bay (Rio de Janeiro, Brazil) by anodic stripping voltammetry in the differential pulse and linear sweep modes. The quantitative implications of heavy metal determinations in polluted sea water and some electrochemical parameters concerning the two voltammetric modes are discussed, as well as the efficiency of the hanging mercury drop mercury film electrodes. Values found for total lead concentration range between 0.07 and 5.4 microgram/kg. Some data are also presented for copper which was shown to interfere at pH greater than 2. (Wheatley-IVI)
W84-01060

INTERLABORATORY STUDY ON DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FISH,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
J. J. Ryan, J. C. Pilon, H. B. S. Conacher, and D. Firestone.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 700-707, May, 1983. 7 Tab, 12 Ref.

Descriptors: *Dioxins, *Chemical analysis, *Fish, Great Lakes, Water pollution effects, Tetrachlorodibenzo-p-dioxin, Chlorinated hydrocarbons.

An interlaboratory round robin study was carried out to estimate the reliability of data on 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in fish. Using different methods, 13 laboratories (4 Canadian, 9 American) agreed to analyze 4 fish samples; 3 were Great Lakes salmonids containing bio-incurred levels of TCDD below 100 ppt and the fourth was an ocean fish fillet containing no measurable TCDD. Samples were sent as freeze-dried portions as it was shown that no change of TCDD occurred by this sample preparation. Results were normalized between laboratories by supplying each with an aliquot of the same 2,3,7,8-TCDD standard. Eight laboratories reported a set of results of which one set was rejected. Values from the 7 remaining laboratories for the 3 positive fish showed mean concentrations in pg/g (ppt) and (CV,%) of 61.2 (13.9), 30.4 (18.4) and 32.3 (25.4). Detection limits averaged 3.6 ppt and ranged between 1 and 10 ppt. No significant differences appeared in the concentration of 2,3,7,8-TCDD in fish samples from methods differing in the use of: (i) digestion or extraction techniques, (ii) high or low resolution mass spectrometry, and (iii) isomer specific or nonspecific separations. Overall recovery values using internal standards varied greatly (29-109%) even within the same laboratory and pointed to the need to use an internal standard to obtain precise results. Agreement among laboratories was good considering the level quantitated (ppt) and the diverse methodology. (Author's abstract)
W84-01062

EXTRACTION AND CLEANUP PROCEDURES FOR DETERMINATION OF DIARYLPHOSPHATES IN FISH, SEDIMENT, AND WATER SAMPLES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, and N. P. Grift.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 684-690, May, 1983. 3 Fig, 6 Tab, 12 Ref.

Descriptors: *Diarylphosphates, *Gas liquid chromatography, *Chemical analysis, Fish, Water pollution, Sediments, Phosphates, *Pollutant identification.

Methods for determination of triaryl/alkylphosphates (TAPs) in water, fish, and sediment were extended to determination of the diarylphosphate (DAP) degradation products. DAPs were extracted from water (adjusted to pH 0.5) by use of XAD-2 resin and determined by gas-liquid chromatography (GLC) as butyl esters. Recoveries of diphenylphosphate (DPP) and o-, m-, p-dicresylphosphates (DoCP, DmCP, DpCP) were > 95% in water samples fortified at 1, 10, and 50 microgram/L. DAPs were extracted from fish with methanol and the extracts were cleaned up on reverse phase (C18) silica cartridges. Recoveries were > 87% for DPP, DoCP, DmCP, and DpCP in fish muscle fortified at 50, 100, and 500 ng/g. Sediments were refluxed with aqueous methanol and DAPs were recovered by use of XAD-2 resin. Recoveries of DAPs from sediments fortified at 50 and 100 ng/g were >76%. Interferences (1-10 ng/g) from phosphorous or nitrogen-containing GLC prevented sub-ng/g level analysis for DAPs in sediment and fish extracts. (Author's abstract)
W84-01063

HIGH RESOLUTION GAS CHROMATOGRAPHY OF CHLORINATED BENZENES,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
L. J. Miller, T. J. Farrell, and B. J. Puma.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 677-683, May, 1983. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Benzenes, *Chlorinated hydrocarbons, *Gas chromatography, Water pollution, Chemical analysis, Chlorinated benzenes, *Pollutant identification.

Chlorinated benzenes are found as contaminants in foods and water. These high production volume chemicals may enter the environment and food chain through improper waste disposal, use as solvents and odor control agents, or as impurities in other industrial chemicals. Because of differences in the electron capture responses of the isomers at each chlorination level, residue quantitation requires the separation of all 12 chlorobenzenes. Resolution was studied on packed and capillary columns coated with Kovats' C-87 H-176 hydrocarbon, OV-101, OV-210, OV-17, and Carbowax 20M. Satisfactory resolution of all 12 chlorobenzenes was obtained with a Carbowax 20M-coated 20 m x 0.25 mm id capillary column operated isothermally at 120 degrees C. (Author's abstract)
W84-01064

GAS-LIQUID CHROMATOGRAPHIC DETERMINATION OF S,S,S,-TRIBUTYL PHOSPHOROTRITHIOATE (DEF) IN WATER AND FISH TISSUE,
Columbia National Fisheries Research Lab., MO.
R. G. Lehmann, L. M. Smith, R. H. Wiedmeyer, and J. D. Petty.
Journal of the Association of Official Analytical Chemists, Vol. 66, No. 3, p 673-676, May 1983. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Defoliants, *Chemical analysis, *Gas chromatography, Fish, Agricultural chemicals, Water pollution, *Pollutant identification.

The widespread use of the cotton defoliant S,S,S-tributylphosphorotrithioate (DEF) suggests the possibility for contamination of freshwater fisheries from runoff and possibly from aerial transport. Methods are described for determination of DEF at levels as low as 5 parts per billion in fish and 200

parts per trillion in water. Fish tissue extracts are subjected to gel permeation chromatography (GPC) and silica gel chromatography; water samples are extracted with dichloromethane. Analyses are carried out by gas chromatography in which either electron capture or thermionic specific detectors are used. The applicability of the methods is demonstrated by analyses of water and fish samples from exposure studies. (Moore-IVI)
W84-01066

LIQUID CHROMATOGRAPHIC DETERMINATION OF GLYPHOSATE IN FORTIFIED SOIL AND WATER SAMPLES,
Agricultural Research Service, Beltsville, MD. Weed Science Laboratory.
R. L. Glass.
Journal of Agricultural & Food Chemistry, Vol. 31, No. 2, p 280-282, March-April, 1983. 2 Fig, 2 Tab.

Descriptors: *Glyphosate, *Chemical analysis, Herbicides, Chromatography, Soil analysis, Pesticide residues, *Pollutant identification.

A high-performance liquid chromatographic (HPLC) method which used fluorescence detection and an amine phase column is described for the determination of glyphosate in fortified soil and water samples after the derivatization of the herbicide. Glyphosate was extracted and subsequently separated with Bio-Rad AG 1-X8 anion-exchange resin (HC03(-)form) prior to derivatizing with the fluorogenic labeling reagent, 9-fluorenylmethyl chloroformate (FMOCCI). The rate of conversion of glyphosate to the glyphosate-FMOCCL derivative was about 60%. The minimum levels of detection for glyphosate were 10 ppb in fortified water, 5 ppm in a sandy loam soil, and 50 ppm in a clay loam soil. Recoveries of glyphosate were greater than 90% in water fortified at 20 ppb-4 ppm, 55% in the sandy loam soil, and about 20% in the clay loam soil fortified at 200 ppm. In comparison to other reported methods this HPLC method is simpler, faster, and specific for glyphosate. (Author's abstract)
W84-01079

LESSONS FROM THE SILICA 'DECLINE' IN LAKE MICHIGAN,
Minnesota Univ., Minneapolis. Limnological Research Center.
J. Shapiro, and E. B. Swain.
Science, Vol. 221, No. 4609, p 457-459, July, 1983. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Water analysis, *Silica, *Lake Michigan, Chicago, Water treatment facilities, Chemical composition, Lakes.

Data obtained from water treatment plants on Lake Michigan were analyzed to see whether a trend could be documented regarding silica concentration in the lake. The analysis was made of the longest post-1948 periods of consistent SiO2 analysis at Chicago, which were 1949-1967 and 1971-1978. Municipal water analyses appear to document some trends, but the results continue to be equivocal on the question of whether Lake Michigan is experiencing progressive change in SiO2 concentration, dissolved or total. In the past, studies have been made which concluded that there was a decline in silica content in the lake. This effort suggests that this purported decline was due to changes in analytical methods and laboratories rather than due to a real change in the chemical composition of the lake's water. (Baker-IVI)
W84-01083

DETERMINATION OF CARBOSULFAN AND CARBOFURAN RESIDUES IN PLANTS, SOIL, AND WATER BY GAS CHROMATOGRAPHY,
FMC Corp., Richmond, CA. Agricultural Chemical Group.
B. C. Leppert, J. C. Markle, R. C. Helt, and G. H. Fujie.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 2, p 220-223, March-April, 1983. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Pesticide residues, *Chemical analysis, Water analysis, *Carbosulfan, *Carbofuran, Gas chromatography, Soil contamination, *Pollutant identification.

Analytical procedures are described for the determination of carbosulfan and carbofuran residues in various crops, in soil, and in water. The quantitative methods involve extraction of residues using hexane-2-propanol or methanol-buffered water followed by column cleanup using Florisil, gel permeation, and Darco-Attaclay plus aluminum oxide, each column alone or in combination with each other. Residues of carbosulfan and carbofuran are detected by gas-liquid chromatography using a nitrogen-selective detector. Good recoveries are achieved with check samples fortified at the 0.05-ppm level with crops and soil and at the 0.01-ppm level with water. (Author's abstract)
W84-01093

PHOTOLYSIS OF THE AQUATIC HERBICIDE FLURIDONE IN AQUEOUS SOLUTION,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
For primary bibliographic entry see Field 5B.
W84-01094

MULTIELEMENTAL AND HYDROCHEMICAL STUDY OF HOLY ZAMZAM WATER,
For primary bibliographic entry see Field 2K.
W84-01095

ENVIRONMENTAL APPLICATIONS OF CAPILLARY GC COLUMNS,
Versar, Inc., Springfield, VA.
S. M. Sonchik.
Journal of Chromatographic Science, Vol. 21, No. 3, p 106-110, March, 1983. 7 Fig, 17 Ref.

Descriptors: *Water analysis, *Pollutant identification, *Gas chromatography, *Capillary analysis, Hazardous materials, Hydrocarbons, *Polychlorinated biphenyls.

Several environmental applications of capillary gas chromatography (GC) analysis using the high resolution achieved with open tubular columns are presented. Suspected environmental problems in landfills, abandoned or active sites, can be verified through the identification of a hydrocarbon layer found on drainage ditch water or in well water using a GC determination of the range of hydrocarbon boiling points to distinguish between gasoline, kerosene, jet fuel or heating oil. The high resolution of the complex hydrocarbon mixture can identify the spill source through careful comparison with possible source materials for subtle differences in mixtures. High resolution GC has also been used in the analysis of PCBs in complex environmental matrices and in the analysis of priority pollutants where the speed of the analysis is important. Not only is capillary analysis quicker than the analysis by packed-column GC/MS, but the fused silica column has the additional advantage of being able to extend directly to the MS ion source. An additional application is in the identification of combustion products from Thermal Destruction Units requiring high resolution separation of the chemical compounds. (Baker-IVI)
W84-01096

THE PRACTICAL APPLICATION OF SURFACE ELECTRICAL RESISTIVITY TO DETECTION OF GROUND-WATER POLLUTION,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
D. W. Urish.
Ground Water, Vol. 21, No. 2, p. 144-152, March-April, 1983. 8 Fig, 1 Tab, 19 Ref. OWRT A-061-RI.

Descriptors: *Groundwater pollution, *Resistivity, *Electrical properties, *Pollutant identification, Field investigations, Brines, Industrial wastes, Leachates, New England.

One of the primary problems in field investigations of ground-water pollution is locating the contaminant plume. Drilling of sampling holes c
miss basis is both time-consuming and
Under many subsurface conditions, surfa
cal resistivity profiling can quickly an
locate the general position of the plume
fy areas most feasible for sampling and m
Many contaminants contain an ionic con
considerably higher than the backgroun
native ground water. When such a cont
introduced into an aquifer, the electrical
of the saturated soil is reduced. Surface
resistivity profiling across a suspected
identify this reduced resistivity zone as
aly. The sensitivity of the method de
relative uniformity of geology and topo
well as minimal extraneous electrical int
It is also essential that the 'A' spacing u
profiling procedure be carefully select
resistivity contrast between contaminate
contaminated ground water is high, dete
least the central part of the plume is lik
expected geologic variation. The metho
successfully used in the location of plu
contaminants including brine, uranium
ing liquid wastes and landfill leachate
deposits of New England. (Author's abst
W84-01122

ACIDITY IN AIR AND WATER IN A WARM FRONTAL PRECIPITATION,
National Center for Atmospheric Resea
der, CO.
A. L. Lazrus, P. L. Haagenson, G. L. Ko
Huebert, and C. W. Kreitzberg.
Atmospheric Environment, Vol. 17, No.
591, 1983. 9 Fig, 5 Tab, 29 Ref.

Descriptors: *Acid rain, *Chemical co
Clouds, Ohio River Valley, Precipitatio
gen sulfide, Sulfates, Nitric acid, Ammo
ity.

The chemical composition of dry air jus
ascending a surface warm front moving
the Ohio River Valley was determined.
the warm frontal precipitation near cloud
4.0. Though the acid content of the air
cient to produce pH 4.0 in 1 g of clo
condensing from 1 cu of air, the overall
tion of the air was inconsistent with that
at cloud base. The agreement between
the air and the pH of the rain at cl
suggests that the amount of pre-exist
rained out in the early stage of precipit
comparable to the observed amount of
generated in the cloud and observed i
cloud water. Both nitric and sulfuric aci
to be generated in clouds, in spite of
solubility of NO2. The average pH of t
cloud base was 4.02, while the overall av
of the warm frontal rain at ground level
The acidity of the precipitation falling
cloud largely inhibited the removal of S
scavenging of acidic aerosols, HNO3
ammonia vapor below the cloud. The aci
tration in the rain at ground level app
versely related to rainfall rate. However,
deposition rate was relatively unchanged
IVI)
W84-01127

**SENSITIVITY ANALYSIS OF THE K
OF ACID RAIN MODELS,**
Massachusetts Inst. of Tech., Cambridge
Lab.
D. Golomb, S. Batterman, J. Gruhl, and W
Atmospheric Environment, Vol. 17, No.
653, 1983. 13 Fig, 2 Tab, 10 Ref. EPRI
RP1484-1.

Descriptors: *Acid rain, *Sulfur compou
trogen compounds, *Mathematical model
ics, Oxidation, Sulfur dioxide, Nitroge
Water pollution sources.

The great number of variables in acid rai
ing makes it difficult to pinpoint those pa
to which the model output (rain acidity)
sensitive. The approach taken here sepa
kinetic and dynamic parts, and analyses t
tivity of the kinetic model alone. Further

nd linearizations are introduced; however, tial steps of the transformation processes ved to be preserved. The major conclu- (a) rain acidity is most sensitive to both tion rates of SO2 to SO4(2-) and NOx to b) dry deposition of the emitted gases, but ormed anions, is important in determining leposition fraction; (c) wet deposition is ter than oxidation, and acidic matter is very rapidly from the air, but it is the rate that determines the total amount of rain and (d) for similar initial concentra- SO2 and NOx, nitrate ions may be the ate species in wet deposition due to the dation and slower dry deposition of NOx to SO2. (Author's abstract)
8

: TRACE ENRICHMENT OF DIFEN- IN WATER AND ITS DETERMINA- HPLC,
nvironmental Center, Vegreville.

f Environmental Sciences and Health, No. 2, p 207-219, April, 1983. 4 Fig, 1 f.

rs: *Difenzoquat, *Pesticide residues, ography, Herbicides, Chemical analysis, lysis, High performance liquid chroma-

at is used throughout the world as a erbicide for the post emergence control ts in barley and fall-seeded wheat. It is a y ammonium salt which is highly soluble nd which partitions strongly in favor of high performance liquid chromatogra- od involving an integrated enrichment cribed for the quantitative determination vels of difenzoquat residues in water. at is trapped from the flowing water strong adsorption onto the enrichment is then desorbed, separated, and subse- alyzed in a single step process by reserve h performance liquid chromatograpy aviolet detection at 255 nm. Average f difenzoquat from organic free water at vels of 20, 10 and 5 ppb was 97.0%. The ction limit reached was 0.25 ppb difen- rganic free water. (Moore-IVI)
)

NEOUS DETERMINATION OF NI- CHLORIDE, SULFATE, AND PHOS- IN NATURAL WATERS BY ION TOGRAPHY,
Univ., Ames. Dept. of Agronomy.
atabai, and W. A. Dick.
Environmental Quality, Vol. 12, No. 2, April-June, 1983. 7 Fig, 1 Tab, 10 Ref.

s: *Chromatography, *Chemical analy- Water analysis, Nitrates, Chloride, Sul- phates, Soil analysis.

us analysis of anions in water samples is udies to evaluate the Dionex Model 10 atogaph (IC) for simultaneous determi- N03(-), Cl(-), SO4(2-), and PO4(3-) in les, including soil extracts, showed that by the IC method agreed closely with ned by the steam-distillation method for lorimetric method using mercuric thio- d ferric ammonlum sulfate for Cl(-), nd colorimetric determination as meth- for SO4(2-), and colorimetric molybde- nethod for PO4(3-). The IC method is eparation of the anions by a separator ntaining Dionex low-capacity anion-ex- n in the HCO3(-) form and on convert- ious anions to their corresponding acids essor column containing a strong acid ange resin in the H(+) form. A solu- M NaHCO3 + 2.4 mM Na2CO3 is used t, and electrical conductivity is used as f detection. The method is precise and nd can detect as little as 0.1 mg/L of Cl(-), SO4(2-)-S, or PO4(3-)-P in water he coefficient of variation ranged from % for NO(3-)-N, from 0.14 to 4.3% for Cl(-), from 0.13 to 1.1% for SO4(2-)-S, and from 0.55 to 8.6% for PO4(3-)-P. With the IC method, the 4 anions indicated can be determined simultaneously in 2 mL of water in approximately 10 min. (Author's abstract)
W84-01197

ROUTINE COLIFORM MONITORING AND WATERBORNE DISEASE OUTBREAKS,
Columbia Univ., New York. School of Medicine.
For primary bibliographic entry see Field 5F.
W84-01204

MINERALIZATION OF ORGANIC MATTER IN WATER BY U.V. RADIATION,
Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
P. Blazka, and L. Prochazkova.
Water Research, Vol. 17, No. 4, p 355-364, April, 1983. 9 Fig, 8 Tab, 23 Ref.

Descriptors: *Mineralization, *Ultraviolet radiation, Water analysis, Hydrogen ion concentration, Carbon dioxide, Oxidation process.

The conditions for the optimum yield of carbon dioxide in the mineralization of organic matter in water were tested and the relative optimum procedure was outlined. Of all substances tested the greatest difficulties were encountered with the purine bases. Their quantitative mineralization was achieved only by the highest irradiation intensities and/or prolonged irradiation. An evident relationship of mineralization and pH was found in urea and thiourea. Adsorption of proteins on silica and glass apparatus was suppressed by phosphoric acid, but a correction of the amount of organic carbon recovered in the blank still had to be applied in protein rich samples. (Author's abstract)
W84-01265

A SENSITIVE METHOD FOR MEASURING ORGANIC CARBON IN SEDIMENT,
Tokyo Univ. (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, Y. Yokoyama, Y. Unno, and S. Suzuki.
Water Research, Vol. 17, No. 4, p 431-434, April, 1983. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Organic carbon, *Sediments, River beds, Analytical methods, Pollutant identification, Solvent extraction.

In order to determine organic carbon in sediments, a sensitive method was devised by the combination of an ordinary wet combustion and TOC analyzer for aqueous samples. The carbon dioxide evolved by wet combustion was absorbed into 0.2 N NaOH solution and determined with a TOC analyzer. The accuracy and the determination limit of the method were determined. Carbon ranges from 0.4 to 48 mg were determined accurately without interference of chlorine and sulfur. This method was applied to the study of the composition of river sediment on the basis of extractability by various solvents. (Author's abstract)
W84-01272

VELOCITY EQUATION FOR WATER QUALITY MODELING IN GEORGIA,
Georgia Dept. of Natural Resources, Atlanta. Environmental Protection Div.
R. Burke, III.
Water Resources Bulletin, Vol. 19, No. 2, p 271-276, April, 1983. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Hydrologic models, *Water pollution control, *Statistical analysis, *Georgia, Physiographic provinces, Stream discharge, Soil types, Velocity, Mathematical studies.

Tabletop water quality modeling still plays an important role in the water pollution control activities of the Georgia Environmental Protection Division. Tabletop models are those developed without the aid of extensive field data. One important component of GEORGIA DOSAG, our basic water quality model, is the equation used to predict flow through velocity. However, Georgia is characterized by wide physiographic diversity which reduces the effectiveness of uncalibrated velocity equations. Using 15 years of accumulated time-of-travel studies, a series of empirical velocity equations were developed and calibrated to various physiographic conditions in Georgia. Equations are available for each major soil province and for three stream flow ranges within each province - $Q<100$cfs, $100<Q<1000$ cfs, and $Q>1000$ cfs. Now, in the absence of extensive field data, we have data based velocity equations which can be tailored to each site under study. (Author's abstract)
W84-01277

PREDICTION OF CHLOROPHYLL A CONCENTRATIONS IN FLORIDA LAKES: THE IMPORTANCE OF PHOSPHORUS AND NITROGEN,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
D. E. Canfield, Jr.
Water Resources Bulletin, Vol. 19, No. 2, p 255-262, April, 1983. 2 Fig, 3 Tab, 39 Ref.

Descriptors: *Chlorophyll a, *Nitrogen, *Phosphorus, Florida, Eutrophic lakes, Mathematical models, Limiting nutrients, Algal growth.

Models for the prediction of chlorophyll a concentrations were developed and tested using data on 223 Florida lakes. A statistical analysis showed that the best model was log (Chl a)= -2.49 + 0.269 log (TP) + 1.06 log (TN/TP) + 1.33 log (TP) where Chl a is the chlorophyll a concentration (mg/cu m), TP is the total phosphorus concentration (mg/cu m) and TN is the total nitrogen concentration (mg/cu m). The model yields unbiased estimates of chlorophyll a concentrations over a wide range of lake types and has a 95% confidence interval of 29-319 percent of the calculated chlorophyll a concentrations. Other models, especially the published Dillon-Rigler and Jones-Bachmann phosphorus-chlorophyll models, are less precise when applied to Florida lakes. The data support the hypothesis that nitrogen is an important limiting nutrient in hypereutrophic lakes. (Author's abstract)
W84-01278

BIOLOGICAL MONITORING OF BLUEGILL ACTIVITY,
Air Force Environmental Hazards Branch, Wright-Patterson AFB, OH. Toxic Hazards Div.
J. W. Fisher, R. A. Dilego, M. E. Putnam, J. M. Livingston, and D. L. Geiger.
Water Resources Bulletin, Vol. 19, No. 2, p 211-215, April, 1983. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Bluegills, *Bioindicators, *Water pollution effects, Hydrocarbons, Fish behavior, Monitoring, Water quality.

Bluegills were exposed for one hour to 0.2 or 2.3 mg/liter water soluble fraction (WSF) of JP-4 in a testing chamber designed to contain individual fish. A strain gage paddle was used to monitor activity. Whole body movement of individual fish did not change appreciably during exposure to either 0.2 or 2.3 mg/liter WSF-JP-4. Strength of pectoral fin movement, accounting for the majority of the fish behavior, increased in six of ten individuals exposed to 2.3 mg/liter WSF-JP-4. Pectoral fanning may be a useful parameter to indirectly assess water quality. (Author's abstract)
W84-01285

USE OF THE FRESHWATER CLAM CORBICULA MANILENSIS AS A MONITOR FOR ORGANOCHLORINE PESTICIDES,
Montgomery (James M.), Inc., Pasadena, CA.
D. M. Hartley, and J. B. Johnson.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 1, p 33-40, July, 1983. 2 Fig, 1 Tab, 25 Ref.

Descriptors: *Pesticides, *Clams, *Monitoring, Chlorinated hydrocarbons, Biological magnification, Bioindicators.

Among the bivalve species in American freshwaters is the Asiatic clam, Corbicula manilensis.

Corbicula offers several advantages as an organism for toxicity testing. It tolerates removal from water for reasonably long periods of time, it can be easily handled in the laboratory and it survives in aquaria without food for periods of up to 6 mo. The bioaccumulation of organochlorine pesticides by Corbicula taken for natural bed, incubated in an aquarium to permit self-cleaning and temporarily implanted in cages in a river was assayed in order to explore the use of temporarily implanted Corbicula for measurement of persistent pollutants in freshwater environments. Eight pesticides, aldrin, dieldrin, hexachlorocyclohexane, lindane, alpha-chlordane, gamma-chlordane, heptachlor, and heptachlor epoxide, were bioconcentrated in clam fat. A period of at least 18 days was required before pesticides in the clam fat came to equilibrium with the pesticide in the water. (Moore-IVI)
W84-01293

USE OF CHROMATICITY IN REMOTE MEASUREMENTS OF WATER QUALITY,
R. P. Bukata, J. E. Bruton, and J. H. Jerome.
Remote Sensing of Environment, Vol. 13, No. 2, p 161-177, May, 1983. 14 Fig, 20 Ref.

Descriptors: *Remote sensing, *Water quality, Lake Ontario, Upwelling, Turbidity, Chromaticity, Chlorophyll a, Organic carbon, Minerals, Optical properties.

The optical cross sections for Lake Ontario water masses have been utilized to study the use of chromaticity analyses for predicting water quality parameters in a water mass which is comprised of chlorophyll, suspended mineral, and dissolved organic carbon (DOC) concentrations. The analyses appear to indicate a very restricted range of such applications. For water masses containing substantial amounts of chlorophyll a or suspended mineral, chromaticity analyses are almost totally ambiguous even if the DOC concentration is known. If the DOC concentration is either known or may be inferred, chromaticity analyses may provide a distinction between clear and turbid waters, but the concentration creating the turbidity would be in doubt. For water masses in which the suspended mineral concentration is know to be moderate, and the DOC concentration is either know or can be estimated, small concentrations of chlorophyll a may be estimated to within a factor of 2. (Moore-IVI)
W84-01300

KEEPING TABS ON EXCESS CHLORINE,
For primary bibliographic entry see Field 7B.
W84-01319

EVALUATION OF EXTRACTION TECHNIQUES FOR THE DETERMINATION OF HEAVY METALS IN RIVER SEDIMENTS,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
N. Watanabe, Y. Yasuda, K. Kato, T. Nakamura, and K. Shimokawa.
Japanese Journal of Limnology, Vol. 44, No. 2, p 123-131, April, 1983. 7 Fig, 3 Tab, 25 Ref.

Descriptors: *Heavy metals, *Sediments, Extraction, Water pollution, Copper, Lead, Cadmium.

In order to distinguish whether heavy metal contents originate from a rock matrix or pollution, six different extraction techniques for copper, lead and cadmium were studied in Nagara River sediments in Gifu Prefecture, Japan. The extraction agents were hydrochloric-nitric acid mixture (1+1), 3N hydrochloric acid solution, 0.5N hydrochloric acid solution, 6 M formic acid solution, 1N hydroxylamine hydrochloride plus 25% acetic acid solution and 0.05N ethylenediaminetetraacetic acid solution. The comparison of the six extraction techniques was conducted on the basis of the heavy metal contents originating from pollution, which was estimated by subtracting background values from total contents. For copper, 3N hydrochloric acid is preferable, but in sediments with poor ignition loss, 0.5N hydrochloric acid and 6M formic acid are recommended. 1N hydroxylamine hydrochloride plus 25% acetic acid is suitable for lead and cadmium. (Author's abstract)
W84-01375

5B. Sources Of Pollution

NEPTUNIUM AND AMERICIUM SPECIATION IN SELECTED BASALT, GRANITE, SHALE, AND TUFF GROUND WATERS,
Geological Survey, Denver, CO.
J. M. Cleveland, T. F. Rees, and K. L. Nash.
Science, Vol. 221, No. 4607, p 271-273, July, 1983. 5 Tab, 6 Ref.

Descriptors: *Waste disposal, *Radioactive wastes, *Speciation, Nuclear powerplants, Americium, Neptunium, Groundwater contamination, Basalts, Sulfates, Granites.

The chemical speciation of neptunium and americium in groundwaters associated with rock types proposed as possible hosts for nuclear waste repositories was examined. The waters used were from the Grande Ronde basalt on the Hanford reservation in Washington, Climax stock granite and tuff from the Nevada Test Site, Cretaceous shale from a rural well near Rapid City, South Dakota, and, for comparison, deionized water. Mobilization of the actinides Np(IV), Np(V), Am(III), and Pu(III) in these groundwaters was minimized by reducing conditions and by high concentrations of sulfate ion, but it is uncertain whether the effect of sulfate could prevail in all groundwaters. The presence of high concentrations of free fluoride had no discernible effect on neptunium and americium solubilities. Since characteristics of chemical composition vary with location within any given host rock type and hence are site specific, it is proposed that the chemical composition of the associated ground water and actual speciation experiments be included along with other relevant parameters as criteria in the selection of geologic sites as possible repositories for nuclear waste. (Baker-IVI)
W84-01086

PHOTOLYSIS OF THE AQUATIC HERBICIDE FLURIDONE IN AQUEOUS SOLUTION,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
D. G. Saunders, and J. W. Mosier.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 2, p 237-241, March-April, 1983. 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Fluridone, *Herbicides, *Photolysis, Lakes, Pollutants, *Pollutant identification, Chemical analysis.

The parameters affecting the photolysis of the aquatic herbicide fluridone, in water are evaluated. The photolysis of fluridone and the formation of benzaldehyde and benzoic acid photoproducts and N-methylformamide were observed in lake and distilled water exposed to sunlight for up to 27 days. The concentration of N-methylformamide increased steadily with 74 and 36% of theory, respectively, being present in the distilled and lake water after 27 days of exposure. In lake water, 3-(trifluoromethyl)benzoic acid and benzoic acid increased steadily, reaching maximums of 33 and 40%, respectively after 21 days. Only trace amounts of the benzaldehydes were observed in both lake and distilled water after 7 days of exposure, and no benzaldehydes were detected after the 14th day. Fluridone half-lives ranged from 22 to 55 hr and were only slightly dependent on fluridone concentration, oxygen concentration, and pH. Results of photolysis experiments with the photoproducts of fluridone are also presented. (McKeon-IVI)
W84-01094

THE REGIONAL EFFECTS OF THE EFFLUENTS FROM THE MISHRAQ SULPHUR MINES IN IRAQ ON THE HYDROLOGICAL SYSTEM,
Mosul Univ. (Iraq).
H. Al-Dabbagh, and M. A. S. Al-Dabbagh.
Hydrological Sciences Journal, Vol 28, No 2, p 311-317, June, 1983. 5 Fig, 3 Ref.

Descriptors: *Sulfur, *Mine wastes, Hy
aspects, *Mishraq, *Iraq, *Permeability co
Observation wells, Groundwater moveme
tion wells.

Sulfur is mined at Mishraq near Mosul, Ira
injection of superheated water. The pr
area is adjacent to and in contact with t
Tigris. With time an increasing numbe
sulfur springs have erupted in and near t
Geological and hydrological studies hav
that faults, fractures and cavities in the
nantly limestone rocks increase the hydra
ductivity and seepage coefficient. The m
tive method of controlling the large-scale
sulfur into the river was by pumping a b
cold water into observation wells bored i
of high hydraulic conductivity, in order t
the sulfur. (Author's abstract)
W84-01105

DISTRIBUTION OF KEPONE IN THE RIVER ESTUARY,
Manhattan Coll., Bronx, NY. Environmen
neering and Science Program.
D. J. O'Connor, J. A. Mueller, and K. J. F
Journal of Environmental Engineering, V
No. 2, p 396-413, April, 1983. 13 Fig, 15 R
grant R-804563.

Descriptors: *Kepone, *James River, *E
*Mathematical models, *Path of pollutan
cide kinetics, Spatial distribution, Tempor
bution, Sediments, Virginia.

An analysis is presented defining the distri
an organic chemical in the water and b
estuarine system. The present structure
model is a tidally averaged two-dimension
tudinal-vertical) main channel interacting
eral embayments. The water column, se
into two layers to incorporate the typical
circulation, interacts with a bed which
segmented into two layers, an active
layer and a deeper stationary bed. Ad
desorption kinetics are included which, in
of Kepone distribution of the James Ri
assumed to be at equilibrium. Both steady
well as time-variable conditions are anal
calibrate the model to reproduce prese
served concentrations of Kepone. A proc
analysis to address the problem of organi
cals in estuaries has been structured. Th
dure involves a series of analytic and comp
al steps, relating to the fluid transport, t
distribution, and the concentrations of the
chemical in the water and the bed. The m
been applied to analyze the temporal an
distribution of Kepone in the James Rive
both constant and time-variable freshwa
conditions. Using actual hydrology and
sumed mass rate of input of Kepone, the
tration was calculated for a 10-yr period
duction, comparing well to observed valu
water and bed. Projections are presented
mate the mass contained in the bed and
charged to Chesapeake Bay. (Author's
W84-01107

GROUND-WATER TRANSPORT WASTEWATER INFILTRATION,
Rice Univ., Houston, TX. Dept. of Enviro
Science and Engineering.
P. B. Bedient, N. K. Springer, E. Baca, T. C
Bouvette, and S. R. Hutchins.
Journal of Environmental Engineering, V
No. 2, p. 485-501, April, 1983. 7 Fig, 3 Tab,
EPA grant CR806931-01.

Descriptors: *Groundwater po
*Wastewater pollution, *Mathematical
Conductivity, Organic compounds, Was
disposal, Chlorides, Simulation, Dispersion,
chusetts.

Ground water contaminant transport was
gated from a municipal wastewater inf
system. Ground water quality samples w
lected at the Fort Devens, Massachusetts
from surrounding wells and were analy
conductivity and trace level organics con

Ground water flow and chloride contaminant
ort were predicted using a two dimensional
ical simulation model. Dispersion estimates
nade using organics data collected at adja-
vells and adjusted for adsorption in the
media. Results for field dispersion com-
favorably with other values reported in the
ire. Methods used in this field project along
odeling techniques should be applicable to
ground water waste contaminant sites. (Au-
bstract)
1110

IENT LOADING ESTIMATES FOR
S,
gical Survey, Sacramento, CA.
t, and G. F. Lee.
l of Environmental Engineering, Vol. 109,
p 502-517, April, 1983. 3 Fig, 2 Tab, 40 Ref.

otors: *Nutrients, *Nitrogen, *Phosphorus,
*Pollution load, Land use, Watersheds,
natical models, Nutrient load.

rogen and phosphorus loads to a waterbody
reliably estimated on the basis of the water-
watershed land use pattern and the nitrogen
osphorus export coefficients for each domi-
pe of land use. Good agreement was found
mparison between the nitrogen and phos-
export coefficients developed in this study
measured amounts of nitrogen and phos-
transported to 38 U.S. waterbodies. Good
ent was also found between the load esti-
by the Vollenweider model relating the
nnual in-lake and inflow phosphorus con-
ons of a waterbody, and the measured
s of phosphorus that actually entered the 38
odies. (Author's abstract)
111

RACTICAL APPLICATION OF SUR-
ELECTRICAL RESISTIVITY TO DETEC-
OF GROUND-WATER POLLUTION,
Island Univ., Kingston. Dept. of Civil and
mental Engineering.
nary bibliographic entry see Field 5A.
122

ERATION AND CHARACTERIZATION
CTERIA INDIGENOUS TO A SHALLOW
R-TABLE AQUIFER,
S. Kerr Environmental Research Lab.,
K.
lson, J. F. McNabb, D. L. Balkwill, and
hiorse.
Water, Vol. 21, No. 2, p 134-142, March-
983. 4 Fig, 2 Tab, 7 Ref.

tors: *Bacteria, *Groundwater pollution,
radation, *Organic compounds, Toluene,
enzene, Bromodichloromethane, Satura-
ne, Vadose water, Soil bacteria, Aquifers,
na.

of the earth below the root zone of soil
nventionally been considered void of life.
r, widespread pollution of ground water in
by organic compounds has kindled inter-
e numbers of microbes that might be found
ers and associated regions of the deeper
ted zone, and in their ability to degrade
pollutants. Newly developed techniques in
l ecology allow the direct enumeration
nination of soil microbes without recourse
cultivation on growth media. These tech-
educe many uncertainties associated with
of culture media, such as the growth of
nants or the failure of indigenous forms to
a particular medium. Samples were re-
aseptically from depths of 1.2, 3.0, and 5.0
m) at the margin of a small floodplain near
klahoma. Depth to the water table was 3.6
l to bedrock was 6.0 m. Numbers of mi-
ere surprisingly similar at all three depths
0 to 9,000,000/g dry material). Although
ram-positive and Gram-negative bacteria
countered, small Gram-positive coccoid
edominated. No protozoa, yeasts, or other
ere seen. The indigenous bacteria could rapidly degrade toluene. Chlorobenzene was degraded in material from the vadose zone, while bromodichloromethane was degraded in material from the saturated zone. There was no detectable degradation of 1,2-dichloroethane, 1,1,2-trichloroethane, trichloroethylene, or tetrachloroethylene. (Author's abstract)
W84-01123

ACIDITY IN AIR AND WATER IN A CASE OF WARM FRONTAL PRECIPITATION,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5A.
W84-01127

SENSITIVITY ANALYSIS OF THE KINETICS OF ACID RAIN MODELS,
Massachusetts Inst. of Tech., Cambridge. Energy Lab.
For primary bibliographic entry see Field 5A.
W84-01128

INTERACTION BETWEEN CO-SOLVENTS AND ALGAE IN THE RESIDUE DYNAMICS OF FENITROTHION,
Ottawa Univ. (Ontario). Dept. of Biology.
P. Weinberger, D. Sher, and R. Greenhalgh.
Journal of Environmental Sciences and Health, Vol. B18, No. 2, p 269-281, April, 1983. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Algae, *Pesticide residues, *Fate of pollutants, Fenitrothion, Bioaccumulation, Chlorophyta, Biodegradation, Solvents.

The specificity of pesticide effects coupled with high rates of pesticide accumulation noted for a range of genera of green algae have been explained as a function of passive partitioning of lipophylic xenobiotics into the lipid pools of the exposed organisms. This study was undertaken to determine whether this totally passive role for the aquatic phytobiota was correct. Fresh and estuarine water algae maintained in laboratory microcosms simulating river-lake/estuary-bay systems were exposed to C14-fenitrothion formulated with Atlox and tank mixed with Aerotex or Dowanol (11.5:1.5:15.5 w/v/v). Generally, the tank mix co-solvents determined the amount of uptake and the array of derivatives formed by the algae. Typically, exposed to an Aerotex mix the ratio of ethyl acetate extractable (NP) fraction : ethyl acetate unextractable (P) fraction was as 3.5:1.0, exposed to a Dowanol mix the ratio was as 1.5:1.0. Within any comparable time period, fresh water algae turned over more of the C14-ring of fenitrothion than the estuarine genera. Turn-over was enhanced when Aerotex was the tank mix co-solvent. Differences in uptake, turn-over, and degradation indicate that algae should be regarded as active rather than passive sinks. (Moore-IVI)
W84-01175

FURTHER WATER SOLUBILITY DETERMINATIONS OF INSECTICIDAL COMPOUNDS,
Department of Agriculture, London (Ontario). Research Centre.
B. T. Bowman, and W. W. Sans.
Journal of Environmental Science and Health, Vol. B18, No. 2, p 221-227, April, 1983. 1 Tab, 14 Ref.

Descriptors: *Insecticides, *Fate of pollutants, *Solubility, Fenamiphos, Fenthion, Methidathion, Carbaryl, Carbophenothion, Aminocarb, Diazinon, Dicapthon, Pirimiphos-ethyl, Pirimiphos-methyl.

The aqueous solubility of 39 pesticides and related compounds was determined at 20 + or - 1.5 C. All samples were analyzed by gas-liquid chromatography. Fenamiphos, fenthion and methidathion had solubilities substantially less than those reported in the literature. Carbaryl and carbophenothion had conflicting literature values, of which one for each compound agreed reasonably well with present data. Aminocarb, diazinon, dicapthon, pirimiphos-ethyl and pirimiphos-methyl gave solubilities substantially greater than their reported literature values. It is hoped that these solubility values will be of use in predicting the environmental fate of insecticides. (McKeon-IVI)
W84-01176

WATER AND NITRATE-NITROGEN LOSSES FROM A SMALL, UPLAND, COASTAL PLAIN WATERSHED,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 2A.
W84-01188

ATMOSPHERIC SULFUR DEPOSITION, NEUTRALIZATION, AND ION LEACHING IN TWO DECIDUOUS FOREST ECOSYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. D. Richter, D. W. Johnson, and D. E. Todd.
Journal of Environmental Quality, Vol. 12, No. 2, p 263-270, April-June, 1983. 4 Fig, 3 Tab, 51 Ref.
RP-1813-1, W-7405-eng-26, DEB-7824395.

Descriptors: *Acid rain, *Leaching, *Hydrogen ion concentration, *Deciduous forests, *Forest soils, Sulfates, Nutrient cycling, Litter, Neutralization, Tennesee.

In the 1981 water year, bulk precipitation was primarily a solution of dilute H2SO4, and SO4(2-) was the dominant anion in throughfall and soil leachates in two eastern Tennessee deciduous forests. Ecosystems inputs of SO4(2-), which included dry deposition of forest canopies, may have been up to 40% greater than input estimates based on atmospheric deposition sampling in open areas. Volume- weighted mean annual pH of bulk precipitation was 4.3; of throughfall 4.8; and of leachates from O2, A1, and B21 soil horizons about 6.0. At both sites, strong acids in precipitation were largely neutralized prior to rainwater's infiltration into mineral soil. Base cations that exchanged with H(+) (hydrogen ions) in acid precipitation were almost entirely supplied by forest canopies and litter layers, and did not come directly from exchangeable mineral soil pools. However, even in these infertile soils with low cation exchange capacities, exchangeable bases were more than two orders of magnitude greater than annual H(+) input in bulk precipitation, and represented a substantial reserve for base cations in canopies and litter layers that exchanged with H(+) in acid rain. Furthermore, inputs of H(+) from acid precipitation were equal to about 0.4% of the base cations that are biologically cycling and immediately available in these ecosystems. Both soils are base-poor Udults and classified as sensitive to acid rain, but the deposition, cycling, and soil data presented in this report indicate that leaching remains a process affecting cation reserves and soil development only over the very long term. (Moore-IVI)
W84-01190

NITROGEN-15-LABELED NITRATE TRANSPORT IN A SOIL WITH FISSURED SHALE SUBSTRATUM,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, F. W. Chichester, and I. Phillips.
Journal of Environmental Quality, Vol. 12, No. 2, p 249-252, April-June, 1983. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Nitrates, *Leaching, *Path of pollutants, Shale, Solute transport, Geologic fractures, Groundwater storage, Fertilizers.

Published data on the fate of N15-labeled fertilizer applied to 4 Coshocton, Ohio, monolith lysimeters showed a series of declining NO3(-) - N concentration maxima in the lysimeter percolate during 3 winter drainage periods subsequent to the single 336 kg/ha fertilizer application. A possible explanation of these concentration maxima as arising from the leaching of previously immobilized and subsequently mineralized N was quantitatively inadequate. In this study, an alternative explanation of these observations was sought. The lowest meter in the 2.44-m deep monolith profile of Keene silt loam consisted of fissured shale bedrock, and analysis of mass conservation of N15-labeled inor-

ganic N in the fissured layer provided an explanation of these observed annually periodic concentration maxima. Some of the calculated flux of labeled N into the top of the fissured layer was shown to be stored within the layer, and to reappear in subsequent annual winter drainage periods. Two possible mechanisms, which allowed such temporary storage, were identified: storage within the pore space of the crack system, and storage in micropores of the weathered rock by lateral diffusion from solution contained in the cracks. (Author's abstract)
W84-01193

ADSORPTION OF DIURON AND 2,4,5-T ON SOIL PARTICLE-SIZE SEPARATES,
Florida Univ., Gainesville. Dept. of Soil Science.
P. Nkedi-Kizza, P. S. C. Rao, and J. W. Johnson.
Journal of Environmental Quality, Vol. 12, No. 2, p 195-197, April-June, 1983. 3 Fig, 2 Tab, 15 Ref. R-805529.

Descriptors: *Herbicides, *Adsorption, *Particle size, Soil contamination, Diuron, Sediments, Non-point pollution sources, Path of pollutants, Organic carbon, Agricultural runoff.

Adsorption is a major process that influences the environmental fate and transport of pesticides in soil-water systems. A major pathway for pesticide removal from croplands is via runoff. During a runoff event, the clay-size and silt-size fractions are selectively carried off the field along with the runoff water. Equilibrium isotherms for the adsorption of herbicides, diuron, and 2,4,5-T on whole soil and various-size separates of Webster soil (Typic Haplaquolls) were measured. The Freundlich adsorption coefficient, K, for diuron varied by a factor of about 7 among the different particle-size fractions. However, the sorption coefficient, K, normalized with respect to soil organic carbon (OC) content, denoted as Koc = (K/OC), varied only within a factor of 1.5. For 2,4,5-T herbicide, the Koc values for the silt and clay-size fractions, as well as the whole soil, were essentially identical and about 3 times larger than that for the sand-size fraction. The results suggested that the soil particle- size separates may be grouped into two size classes: 'fine' (< 50 micro m) and 'coarse' (2,000-50 micro m). For a given pesticide, a specific Koc value may be assigned to each class. (Moore-IVI)
W84-01199

RESPONSE OF SPRUCE AND BIRCH FOLIAGE TO LEACHING BY ACIDIC MISTS,
Vermont Agricultural Experiment Station, Burlington.
T. Scherbatskoy, and R. M. Klein.
Journal of Environmental Quality, Vol. 12, No. 2, p 189-195, April-June, 1983. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Acid rain, *Leaching, *Throughfall, Cycling nutrients, Metabolites, Precipitation, Birch, Spruce, Trees.

Seedlings of yellow birch (Betula alleghaniensis Britt.) and white spruce (Picea glauca (Moench) Voss) were exposed to mists consisting of distilled water at pH 5.7, or sulfuric acid in distilled water at pH 4.3 or 2.8. Misting treatments, 4 h each, were applied once, twice or three times, separated by 72 h. Leaf tissue chlorophyll concentrations were determined, and foliar leachate was analyzed for K(+), Ca(2+), NO3(-), H2PO4(-), total carbohydrate, total protein, and total amino acids. Decreased leaching of carbohydrate, protein, K(+), and H2PO4(-) occurred with increasing number of mistings, indicating that these substances were not readily resupplied to leaching sites. Protein leaching was reduced by misting at pH 2.8. Leaching of amino acids, K(+), and Ca(2+) increased with decreasing mist pH, and leachate pH was higher than the pH of applied mists, suggesting that cation exchange plays a role in foliar leaching by acidic solution. Amino acid leaching from birch increased with increasing number of mistings at pH 2.8. There was no strong effect on chlorophyll concentrations, and leaching of NO3(-) and H2PO4(-) did not vary with mist pH. (Author's abstract)
W84-01200

CONTINUED STUDIES OF ACID RAIN AND ITS EFFECTS ON THE BATON ROUGE AREA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
J. W. Robinson, and H. Ghane.
Journal of Environmental Science and Health, Vol. A18, No. 2, p 165-174, 1983. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Acid rain, *Water pollution effects, Baton Rouge, Louisiana, Surface drainage, Wind, Water pollution sources, Dissolved oxygen, Seasonal variation, Lakes, Rainfall.

The acidity of rain water was measured in the Baton Rouge, Louisiana area from June 1981 to September 1982. Coordinated measurements were taken of the dissolved oxygen concentration in two local lakes before and after each rainfall. About 50% of the rainfall observed was quite acidic, with about 25% of the rain having a pH of 4 or less. Rain was more acidic during warm summers than in the winter weather. Rainfall during 1982 was, on a month to month comparison, more acidic than in 1981. Attempts were also made to discover any possible correlation of pH values with wind direction. The acidity of each of the two lakes increased over the time of the study. The dissolved oxygen content in each lake increased after periods of rain, probably due to a high concentration of oxygen in the rainwater. The buffering capacities of the lakes was measurable. However, it is noted that the larger lake was undergoing dredging at the time of the study and showed considerably less buffer capacity than the smaller lake. The smaller lake was far more affected by surface drainage and thus should have been more influenced by the acid rain. (Baker-IVI)
W84-01211

ASSESSMENT OF THE CHEMICAL AND BIOLOGICAL SIGNIFICANCE OF ARSENICAL COMPOUNDS IN A HEAVILY CONTAMINATED WATERSHED PART II. ANALYSIS AND DISTRIBUTION OF SEVERAL ARSENICAL SPECIES,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
S. D. Faust, A. Winka, T. Belton, and R. Tucker.
Journal of Environmental Sciences and Health, Vol. A18, No. 3, p 389-411, 1983. 3 Fig, 6 Tab, 10 Ref.

Descriptors: *Arsenic compounds, *Water pollution sources, Union Lake, New Jersey, Sediment contamination, Chemical analysis, Pore water, Monomethlyarsonic acid, Dimethlyarsinic acid, Industrial wastes.

The waters and bottom sediments in the watershed of Union Lake in southern New Jersey are highly contaminated with substantial quantities of arsenic. The single source of this contamination is an industrial manufacturer of arsenical compounds in the headwaters of this watershed. Total arsenic contents were as high as 2780 micro g/1 in the water phase, whereas 2290 micro g/1 was the highest observed in bottom sediments. Pore water from this bottom sediment was 12,500 micro g/1. Arsenic contents in the bottom sediments were 4240 times those found in overlying waters. In sediments, the order of predominance of the four arsenic species was: As(+5) > As(+3) > monomethylarsonic acid (MMAA) > dimethylarsinic acid (DMAA). In four of the sediments, the inorganic arsenate was 72.8, 81, 84, and 88% of the total arsenical species. In water, the order of predominance was MMAA > As(+3), As(+5) > DMAA. Difficulties with the analytical procedure for separation of the four arsenical species include erratic recoveries of the four arsenical species from the cation exchange column, and difficulties in the separation of As(+3) and As(+5). (Moore-IVI)
W84-01212

ASSESSMENT OF THE CHEMICAL AND BIOLOGICAL SIGNIFICANCE OF ARSENICAL COMPOUNDS IN A HEAVILY CONTAMINATED WATERSHED. PART I. THE FATE AND SPECIATION OF ARSENICAL COMPOUNDS IN AQUATIC ENVIRONMENTS - A LITERATURE REVIEW,
Rutgers - The State Univ., New Brunswic
Dept. of Environmental Science.
N. V. Lemmo, S. D. Faust, T. Belton, and R.
Tucker.
Journal of Environmental Sciences and
Vol. A18, No. 3, p 335-387, 1983. 6 Fig, 8
Ref.

Descriptors: *Arsenic, *Arsenic comp
Chemical reactions, Fate of pollutants,
pollutants, Chemical analysis, Water pollutio
erature reviews.

The analysis for total arsenic is no longer su
to describe this contaminant in aquatic en
ments. Arsenic can undergo extensive ch
and biochemical transformations in an a
system. Since each of the resulting arsenic
pounds differ in their toxicity to humans
important to follow these transformations. E
ing the transformations under various chemic
physical conditions will aid in predicting th
mate fate of the arsenicals in a given aquatic
ronment. In order to follow the transformati
is first necessary to identify and quantitate th
is important that the speciation procedures
be simple and adaptable to analyzing many
ples. The review provides a summary of the
istry of arsenite, arsenate, monomethylarsonic
and dimethylarsinic acid (cacodylic acid),
transformations in an aquatic environment,
review of the methods developed to speciate
compounds. (Author's abstract)
W84-01213

**GROUNDWATER FLOW AND IMPLICAT
FOR GROUNDWATER CONTAMINA
NORTH OF PREWITT, NEW MEXICO, U**
New Mexico Inst. of Mining and Techno
Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2F.
W84-01215

**LONGITUDINAL DISPERSION CO
CIENTS FOR VARYING CHANNELS,**
Cambridge Univ. (England). Dept. of Ap
Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 130, p 29
May, 1983. 5 Fig, 13 Ref.

Descriptors: *Path of pollutants, *Dispersion
ficient, *Flow characteristics, Mathem
models, Channel morphology, Water depth,
ondary flows, Upstream memory.

Although most flows in nature vary along
length, most theoretical work on longitudinal
taminant dispersion has concerned longitudi
uniform channels. It is justifiable to use su
uniform model only if the lengthscale for m
across the channel is less than the lengthscal
channel variations. A general expression is
tained for the longitudinal dispersion coeffi
for a passive contaminant in a varying cha
This expression reveals the upstream me
character of the dispersion coefficient. Simpl
amples are used to illustrate the effects of: a su
change in breadth, centrifugally driven secon
flows, and changes in the depth profile. (Mo
IVI)
W84-01237

**EFFECT OF LIMING AND LEACHING
THE SULFUR-SUPPLYING CAPACITY
SOILS,**
International Fertilizer Development Center,
cule Shoals, AL. Agro-Economic Div.
L. Korentajer, B. H. Byrnes, and D. T. Hellums
Soil Science Society of America Journal, Vol.
No. 3, p 525-530, May-June, 1983. 2 Fig, 6 Tab
Ref.

Descriptors: *Leaching, *Sulfur, *Liming eff
Fertility Gypsum, Percolation, Corn.

A greenhouse experiment was conducted to ev
ate the effect of liming and subsequent percolat
on SO4(--) leaching from two soils differing
stantially in their native soil S status. Two crop

Zea mays L.) were then grown on the limed ached soils with gypsum added in order to S crop response. With no liming, SO4(--) g losses in both soils were approximately f those obtained at the highest liming rates. g/kg); however, the effect varied depend- the soil S status. In the soil with the higher f absorbed SO4(--) (35 micrograms/g of S), ching losses were more gradual, and SO4(--) followed a chromatographic pattern com- observed with nonsorbing ions. Possible itions for these patterns are presented. Crop tion and S uptake, particularly by the crop, reflected the significant effects of and leaching on the available S status of the he results indicate that acid soils that are and subsequently leached may rapidly S deficient and that the relative amounts of d SO4(--) and mineralizable S are important in determining the magnitude of the liming Author's abstract)
258

IFICATION OF THE FLAME RETAR- TETRABROMOBISPHENOL-A IN THE SEDIMENT, AND THE MUSSEL COL- D IN OSAKA,
Prefecture Inst. of Public Health (Japan).
nabe, T. Kashimoto, and R. Tatsukawa.
of Environmental Contamination and ogy, Vol. 31, No. 1, p 48-52, July, 1983. 5 ef.

tors: *Brominated hydrocarbons, *Flame nts, *Water pollution, Mussels, Sediment nation, Biodegradation, Chemical degrada- enols, Japan.

sediment was collected at Neya River, a of the Yodo River, which empties into Bay, in September, 1981. Tetrabromobis- A (TBBP) was identified in the river sedi- d the dimethyl ether deriviative of TBBP DM) was identified in the mussels. TBBP n as a most suitable flame retardant for nd polyester resins. The level of TBBP in ment was about 20 ppb on a dry weight BBP was not identified in the mussels, but M was found at about 5 ppb. This TBBP- ght have been formed from TBBP by or biological reactions in the environ- d subsequently accumulated in the mus- ore-IVI)
94

TION OF MUTAGEN BY PHOTOLY- AROMATIC COMPOUNDS IN WATER INING NITRITE ION,
Univ. of Tokyo. (Japan). Faculty of Phar- al Sciences.
, T. Hagino, T. Ueki, Y. Nishi, and S.
of Environmental Contamination and gy. Vol. 31, No. 1, p 79-84, July, 1983. 1 b, 14 Ref.

ors: *Mutagens, *Hydrocarbons, *Nitrites, sis, Aromatic compounds, Ultraviolet ter pollution, Benzenes.

polycyclic aromatic hydrocarbons, and stituted benzenes were irradiated for 3 hr 0 W high-pressure mercury lamp in aque- e solution. Ether extracts from the reac- ures were tested for mutagenicity using la typhimurium TA 98. The ether extracts n mixtures of all compounds were muta- cept for aniline and benzenesulfonate. e light source was equipped with a Pyrex r, most of the ether extracts were muta- cept those from biphenyl, toluene, and lfonate. The wavelength characteristics ght are analogous to sunlight. Based on the formation of mutagens from organic ds in aquatic environments is probably by sunlight. (Moore-IVI)
95

ACID-ENHANCED BIODEGRADA- AQUATIC CONTAMINANTS,
National Water Research Inst., Burlington (Ontario).
D. Lui, J. Carey, and D. Thomson.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 2, p 203-207, August 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Fate of pollutants, *Fulvic acid, *Humic acids, *Biodegradation, Thiazoles, Bacteria, Industrial wastes, Water pollution.

Humic substances are widely distributed in the enviroment and have been known to enhance the photochemical degradation of synthetic organics in the aquatic environment. Naturally occurring fulvic acid (FA) is found to enhance the biodegradation of synthetic organics in experiments using 2-(methlythio)benzothiazole (MMBT) as an model contaminant. The FA was extracted from water of the Grand River, Ontario. For use as the inoculum, a MMBT degrading bacterial culture was derived from the activated sludge of a sewage treatment plant receiving wastewater from a firm manufacturing chemicals for the rubber industry. The ability of FA to stimulate biodegradation was clearly demonstrated. MMBT was degraded faster in a fermentor containing FA (half-life 60 hr) than in one without FA addition (half-life 104 hr). Since a large portion of dissolved organic matter in fresh water is present as fulvic acid, this enhanced biodegradation may play an important role in determining the fate of aquatic contaminants. (Moore-IVI)
W84-01297

SULPHUR IN SEDIMENTS CHRONICLES PAST CHANGES IN LAKE ACIDIFICATION,
J. O. Nriagu, and R. D. Coker.
Nature, Vol. 303, No. 23, p 692-694, 23 June, 1983. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Sulfur, *Acid rain, *Sediments, Water pollution sources, Lake acidification, Sulfur isotopes, History, Ontario.

Sulfur pollution has closely been linked to the problems of acid precipitation and lake acidification. Although variations in sulfur isotypes can in principle be used to fingerprint the sources of sulfur in the lacustrine environment no attempt has so far been made to apply the technique in the study of pollutant sulfur in lakes in an historical sense. The concentrations and isotopic composition of sulfur in sediments of several softwater lakes of northern Ontario are reported. Lakes in the first group are located near Sudbury and are expected to derive most of their sulfur from the big nickel-copper smelter nearby. The second group of lakes are located in the more remote Algonquin Provincial Park with no know major local sources of sulfur. The sensitivity of the sediments to the influx of sulfur from local or distant sources is clearly demonstrated. (Moore-IVI)
W84-01301

BIOCONCENTRATION AND FIELD DISSIPATION OF THE AQUATIC HERBICIDE FLURIDONE AND ITS DEGRADATION PRODUCTS IN AQUATIC ENVIRONMENTS,
Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
S. D. West, R. O. Burger, G. M. Poole, and D. H. Mowrey.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 3, p 579-585, May/June, 1983. 12 Tab, 20 Ref.

Descriptors: *Biological magnification, *Fluridone, *Biodegradation, Herbicides, Fish, Pesticide residues, Aquatic environment, Hydrosoil, Aquatic weed control, Mathematical models.

The accumulation and dissipation patterns of the aquatic herbicide fluridone, 1-methyl-3-phenyl-5-(3-(trifluoromethyl)phenyl)-4(1H)-pyridinone, and its major degradation products have been determined in 40 pond and lake experiments in the United States, Panama, and Canada. The average bioconcentration factor for the total residue of fluridone plus a single major metabolite, 1-methyl-3-(4-hydroxyphenyl)-5-(3-trifluoromethyl)phenyl)-4(1H)-pyridinone, in several fish species was 1.33, 7.38, and 6.08 in edible tissue, inedible tissue, and whole body, respectively. Fluridone dissipated with an average half-life of 20 days in pond water and 3 months in pond hydrosoil. The treatment of small areas (0.8-4.0 ha) of large lakes resulted in more rapid dissipation due to dispersal of fluridone into the surrounding untreated water. Little or no carry-over of residues occurred prior to annual retreatments of the ponds. Mathematical models were evaluated for relating the half-life of fluridone in pond water to physical and chemical properties of the water. (Author's abstract)
W84-01304

BIOACCUMULATION OF ARSENIC BY FRESHWATER ALGAE AND THE APPLICATION TO THE REMOVAL OF INORGANIC ARSENIC FROM AN AQUEOUS PHASE. PART I. SCREENING OF FRESHWATER ALGAE HAVING HIGH RESISTANCE TO INORGANIC ARSENIC,
Kagoshima Univ. (Japan). Dept. of Applied Chemistry.
S. Maeda, T. Kumamoto, M. Yonemoto, S. Nakajima, and T. Takeshita.
Separation Science and Technology, Vol. 18, No. 4, p 375-385, 1983. 4 Fig, 4 Tab, 11 Ref.

Descriptors: *Algae, *Arsenic, *Fate of pollutants, *Bioaccumulation, Chlorella, Diatoms, Cyanophyta, Chlorophyta, Protozoa, Rotifers, Bacteria, Mine wastes, Geothermal power, Effluent.

Several freshwater alga having resistance to arsenic were screened from microorganisms which had been sampled at sites polluted with arsenic from a geothermal electric power plant and old mines and smelters and arsenic ores. The alga thus screened could grow in the liquid medium (Modified-Detmer culture medium) containing sodium arsenate at levels up to 2000 ppm as elemental arsenic concentration. Some mixed systems of alga grew rapidly in the media at the higher levels of arsenic ranging from 50 to 2000 ppm. The mixed systems of alga screened included predominantly blue-green algae, green algae, and diatoms, and also included protozoa, rotifera, and bacteria as minor components. One pure algal culture was obtained by means of an agar plate culture, and the algae isolated was identified as Chlorella vulgaris Beijerinck var. vulgaris. The growth of C. vulgaris in a pure culture was unaffected by 100 ppm of arsenic. (Author's abstract)
W84-01307

SEASONAL VARIATIONS OF CD, PB, CU AND NI LEVELS IN SNOW FROM THE EASTERN ARCTIC OCEAN,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
L. Mart.
Tellus, Vol. 35B, No. 2, p 131-141, April, 1983. 1 Fig, 8 Tab, 37 Ref.

Descriptors: *Snow, *Heavy metals, *Arctic, Lead, Cadmium, Copper, Nickel, Cobalt, Seasonal variation, Air pollution.

During the Swedish Arctic expedition 'Ymer 80' into the area from North Greenland to Franz-Josef-Land in late summer 1980, freshly fallen snow, and snow from the previous fall/winter season were collected from ice floes. Lead, cadmium and copper analysis was performed on board ship, using the advanced voltammetric determination method of differential pulse anodic stripping voltammetry at rotating glassy carbon electrodes. The analytic operations were performed under a clean bench in a clean room container. Nickel, and tentatively, cobalt levels were analyzed in the home laboratory by differential pulse voltammetry after preconcentration by chelate adsorption at a hanging mercury drop electrode. Results from freshly fallen snow compared to snow from the previous season show that there exists a strong seasonal variation in trace metal deposition, indicating that pollution of the Arctic atmosphere is clearly limited to winter time, when atmospheric conditions favor long-distance transport of polluted air masses from Europe to the Arctic. Unexpectedly low mean levels of 0.4 ng/kg Cd, 13 ng/

kg Pb, 20 ng/kg Cu and 22 ng/kg Ni were found in freshly fallen snow, levels that represent about 1/10 to 1/20 of those in annual condensed layers. (Author's abstract)
W84-01308

A NOTE ON FRACTURE FLOW DISPERSION MECHANISMS IN THE GROUND,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2F.
W84-01338

SIMULATION OF SOLUTE TRANSPORT IN A CHEMICALLY REACTIVE HETEROGENEOUS SYSTEM: MODEL DEVELOPMENT AND APPLICATION,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. W. Miller, and L. V. Benson.
Water Resources Research, Vol. 19, No. 2, p 381-391, April, 1983. 8 Fig, 2 Tab, 24 Ref. DEAC03-76SF00098, DOE 50-80-97.

Descriptors: *Solute transport, *Route of pollutants, Advection, Diffusion, Mathematical models, Ion exchange, Mass action, Water dissociation, Strontium, Groundwater pollution, Aqueous complexation.

One-dimensional transport of solutes in a saturated porous medium has been simulated using a numerical model CHEMTRN. This model includes dispersion/diffusion, advection, ion exchange, formation of complexes in the aqueous phase, and the dissociation of water. The mass action, transport, and site constraint equations are expressed in a differential/algebraic form and solved simultaneously. In the mass action equations describing complexation and sorption processes, the activities of the species in the aqueous phase are approximated using the Davies equation. A solubility constraint can be set at the inner boundary. The model was applied to a study of the migration of strontium in groundwater. Results show that surface site competition is important when the strontium concentration is comparable to the background electrolyte concentration, in which case a constant k sub D model does not simulate the transport of chemical species adequately. In addition, the pH level was buffered to a level of approximately 10 near the wasteform due to the incorporation of the solubility constraint. For the particular case studied, the incorporation of aqueous complexation did not significantly enhance strontium mobility. (Author's abstract)
W84-01340

COMBINED MIXING CELL/ANALYTICAL MODEL TO DESCRIBE TWO-DIMENSIONAL REACTIVE SOLUTE TRANSPORT FOR UNIDIRECTIONAL GROUNDWATER FLOW,
Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
H. D. Schulz, and E. J. Reardon.
Water Resources Research, Vol. 19, No. 2, p 493-502, April, 1983. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater movement, *Solute transport, Mathematical models, Mixing, Ion exchange, Chemical precipitation, Advection, Dispersion, Calcite, Path of pollutants.

A combined two-dimensional mixing cell/analytical solution is presented which describes multiple reactive solute transport in unidirectional groundwater flow regimes. The model uses a two-step solving routine which separates chemical equilibria computations (ion exchange and mineral precipitation/ dissolution) from calculations of advection/ dispersion. Before running the model for a particular grid configuration, an isochemical flow situation is run first to calibrate the model. The calibration technique adjusts for mass losses or gains to and from cells, which occurs when using mixing cell models. Computational time for calculating chemical equilibria in each mixing cell is markedly reduced by the use of a single-equation solution to solve for multi-ion exchange equilibria and a rapid iterative technique to solve for calcite equilibria. The application of the model to simulate a solution injection experiment into an unconsolidated sand deposit yielded results in reasonable agreement with field observations. (Author's abstract)
W84-01351

EFFECTS OF LIGHT AND THE IMPORTANCE OF LIVING PLANT TISSUES ON THE FATE OF (14C)PHORATE IN WATER AND ELODEA PLANTS,
Wisconsin Univ.-Madison. Dept. of Entomology.
G. Walter-Echols, and E. P. Lichtenstein.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 3, p 637-641, May/June, 1983. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Pesticide residues, *Light effects, *Elodea, Vegetation, Plant physiology, Carbon radioisotopes, Insecticides, Metabolism, Water pollution effects.

The importance of living plant tissues and light on the uptake and metabolism of C-14 phorate-derived residues from water by Elodea nuttallii plants was investigated. Plants growing for 2 weeks in water with a bottom deposit of C-14 phorate-treated soil accumulated in their tissues up to 30% of the originally soil-applied radiocarbon and 56% when the insecticide had been directly applied to the water. Most of the C-14 labeled compounds thus taken up were bound to plant tissues, which might explain the small amounts of radiocarbon released later from these plants into insecticide-free water. The uptake of insecticides from water was a function of the living plant, since dead plant tissues contained only small amounts (2.6% of that found in living plants) of C-14 labeled compounds after having been exposed for 72 h to C-14 phorate-contaminated water. Moreover, most of the C-14 phorate-derived compounds (38.4% of applied) were taken up by Elodea plants when exposed to light, while plants incubated in the dark contained only 9% of the radiocarbon originally applied to the water. (Author's abstract)
W84-01371

STUDIES ON THE BEHAVIOUR OF NUTRIENTS IN THE MANDOVI ESTUARY DURING PREMONSOON,
National Inst. of Oceanography, Panaji (India).
For primary bibliographic entry see Field 2L.
W84-01385

BEHAVIOUR OF COPPER, ZINC, IRON AND MANGANESE DURING EXPERIMENTAL RESUSPENSION AND REOXIDATION OF POLLUTED ANOXIC SEDIMENTS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
J. M. Hirst, and S. R. Aston.
Journal of Estuarine, Coastal and Shelf Science, Vol. 16, No. 5, p 549-558, May, 1983. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Suspended sediments, *Estuarine environment, *Water pollution, *Metals, Resuspension, Oxidation, Copper, Zinc, Iron, Manganese, Water temperature, Salinity, Hydrogen ion concentration, Oxygen concentration, Path of pollutants.

Samples of anoxic intertidal sediments from the Mersey Estuary, north-west England, have been used in laboratory experiments to determine the rates and extents of metal (Cu, Zn, Fe, Mn) releases to solution under conditions of controlled resuspension and reoxidation. An experimental system for the study of sediment-water interactions at various temperatures, salinities, pHs and oxygen concentrations is described. The results indicate rapid initial losses of Fe and Mn from sediment but not Cu and Zn with longer term readsorption of Fe and Mn to give partitioning between the aqueous/sediment phases for all four metals which is similar to that under the initial anoxic conditions. Cu and Zn show small, but measurable, net losses from the aqueous phase to the reoxidized sediment. Salinity variations exert little influence on the processes observed, but increasing temperature produces increased Cu, Zn and Mn in the dissolved fraction at equilibrium conditions. Exchan Cu and Zn between the sediment/water pha rather insensitive to pH or oxygen concentr but Fe and Mn do respond to increasing pH suppress their initial release on oxidation. oxygen concentrations can result in a slo significant release of Fe. In relation to trace pollution in estuaries and biological avail the results suggest that the resuspension and tion of polluted anoxic sediments is not an i tant process because of scavenging of metals on to the resuspended material. (A abstract)
W84-01396

5C. Effects Of Pollution

OCCURRENCE AND PATHOGENICITY NAEGLERIA FOWLERI IN ARTIFICIL HEATED WATERS,
Pittsburgh Univ., PA. Graduate School of Health.
J. L. Sykora, G. Keleti, and A. J. Martinez.
Applied and Environmental Microbiology, 45, No. 3, p 974-979, March 1983. 1 Fig, 4 T Ref.

Descriptors: *Thermal pollution, *Pathogeni tozoa, *Cooling water, *Naegleria fowleri, sylvania, Protozoa, Pathogens, Powerplants drogen ion concentration, Cooling towers.

The occurrence of pathogenic N. fowleri in mal discharges, recipient waters, and co towers of eight power plants located in w Pennsylvania was investigated for 2 yr in co tion with several environmental measure Pathogenic N. fowleri was detected in one co tower and in the discharge, receiving wate both of five of eight localities. The occurren this organism was related to elevated tempera but no significant correlation was found for biological and chemical parameters. Labor experiments on the effect of pH on pathogen fowleri documented 100% survival at a range 2.1 to 8.15. Higher pH reduced or killed the bae. No case of human primary amoebic goencephalitis occurred. (Author's abstract)
W84-01055

SURVIVAL OF NATURAL SEWAGE POP TIONS OF ENTERIC BACTERIA IN DI SION AND BATCH CHAMBERS IN MARINE ENVIRONMENT,
Rhode Island Univ., Kingston. Dept. of Mic ology.
E. J. Lessard, and J. M. Sieburth.
Applied and Environmental Microbiology, 45, No. 3, p 950-959, March 1983. 6 Fig, 1 Ta Ref. EPA grants R804866010 and R80486 NSF grant OCE-7681779.

Descriptors: *Escherichia coli, *Estuarine env ment, *Salt marshes, *Enteric bacteria, Se bacteria, Wastewater pollution, Temperatur fects, Light effects, Rhode Island, Narraga Bay, Bisset Cove.

The survival of natural populations of Escher coli and enterococci in sewage was measure large-volume diffusion chambers in an estuary a salt marsh. The 5-liter chambers, with poly bonate membrane sidewalls, were found to be able for up to week-long experiments. Decay measured monthly from February to August ranged from 0.042 to 0.088/hr (time for 90% o population to die = 25 to 55 hr) for E. coli 0.019 to 0.083/hr (time for 90% of the popul to die = 29 to 122 hr) for enterococci and significantly correlated with temperature. In trast to the diffusion culture experiments, decay of E. coli in batch culture did not corr with temperature. Enterococci survived lo than E. coli in the Narragansett Bay (estu experiments, but survived less well in the eutrophic salt marsh. The effect of light on sur al was examined with light/dark experiments sampling at frequent intervals over the diel c Diel changes in survival were not evident in Narragansett Bay experiments. E. coli, howe

d a diel pattern of growth during the day
th at night in the salt marsh. There was no
nt difference in decay rates between light
k diffusion chambers, nor were decay rates
ed with light intensity. In concurrent batch
ents, survival was significantly greater in
for both organisms. These results suggest
effect of light is complex and that condi-
batch culture may modify the survival of
bacteria. Observations made in diffusion
rs may more closely follow the in situ
of enteric microorganisms. (Author's ab-

056

T ST. HELENS ERUPTIVE IMPACTS
E TOUTLE COMMUNITY GROUND-
SUPPLY,
Edwards and Associates, Inc., Kelso, WA.
nary bibliographic entry see Field 5F.
058

LABORATORY STUDY ON DETERMI-
N OF 2,3,7,8-TETRACHLORODI-
-P-DIOXIN IN FISH,
and Welfare Canada, Ottawa (Ontario).
Protection Branch.
nary bibliographic entry see Field 5A.
062

T OF PHENOL MOLECULAR STRUC-
ON BACTERIAL TRANSFORMATION
CONSTANTS IN POND AND RIVER
ES,
mental Protection Agency, Athens, GA.
ris, N. L. Wolfe, W. C. Steen, and G. L.
an.
and Environmental Microbiology, Vol.
3, p 1153-1155, March, 1983. 1 Fig, 2 Tab,

ors: *Phenols, *Microbial degradation,
lar structure, Bacteria, Substituted phen-
utants, Microbial rate constants.

l transformation rate constants for a series
ls were correlated with a property of the
nts, van der Waal's radius. The com-
used were phenol, p-methylphenol, p-
phenol, p-chlorophenol, p-bromophenol,
henol, p-cyanophenol, and p-nitrophenol.
amples collected from five sites within 10
Athens, Georgia, were used in order to
revious studies to mixed populations from
waters. Transformation products were the
nding catechols, with the exception of p-
benzoic acid, the product of p-acetyl-
A different product suggested a different
; p-acetylphenol, therefore, was deleted
data base. (Moore-IVI)
090

EFFECTS OF TWO ORGANOPHOS-
S PESTICIDES ON FRUCTOSE-1,6-DI-
HATE ALDOLASE ACTIVITY OF
BRAIN AND GILLS OF THE FRESH-
FISH CLARIAS BATRACHUS,
v Univ. (India). Dept. of Zoology.
ndon, and A. Dubey.
mental Pollution (Series A), Vol. 31, No.
May, 1983. 2 Tab, 17 Ref.

ors: *Organophosphorus pesticides, *Tox-
Enzymes, *Clarias batrachus, Aldolase,
n, Dimecron, Water pollution effects,

ruse of pesticides and other chemical in
gricultural and public health operations
es adversely affects non-target organisms
freshwater fish. The activity of different
in the body may be altered, and finally
curs. Exposure to different concentrations
organophosphorus pesticides, malathion
0 ppm) and dimecron (2.50-6.00 ppm), in
roduced elevated aldolase activity in the
ain and gill tissues of the freshwater fish
atrachus, exposed for periods of 24 to 96
toxic conditions produced by the pesticide ultimately caused the death of the fish owing to the failure of the respiratory center of the brain. The breakdown of proteins and the diabetic condition caused by the organophosphorus pesticide toxicity appeared to be the possible cause of increased aldolase activity. (Moore-IVI)
W84-01113

ENUMERATION AND CHARACTERIZATION OF BACTERIA INDIGENOUS TO A SHALLOW WATER-TABLE AQUIFER,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W84-01123

PHYSIOLOGICAL CHANGES IN CARPS INDUCED BY POLLUTION,
Karlsruhe Univ. (Germany, F.R.). Dept. of Zoology II.
W. Hanke, G. Gluth, H. Bubel, and R. Muller.
Ecotoxicology and Environmental Safety, Vol. 7, No. 2, p 229-241, April, 1983. 9 Fig, 27 Ref.

Descriptors: *Pesticides, *Carp, *Toxicity, *Bioassay, *Enzymes, Indicators, Bioindicators, Cortisol, Glucose, Glycogen, Atrizine, Insecticides, Fungicides, Herbicides.

Physiological changes in carp were evaluated for use as indicators of pollutants in environmental water systems. The pesticide DDT, the herbicide atrazine, the fungicides PCP and HCB, and the insecticides dieldrin, lindane and aldrin were used as test pollutants. The pollutants induce changes in cortisol and glucose levels in serum, variations in the amount of liver glycogen and liver function, changes in gill ATPase and brain and serum acetylcholinesterase of carp. There is always a biphasic response, with an increase in the concentration or enzyme activity for a short time, and a decrease or inhibition of the enzymes after a longer exposure to the pollutants. The time scale (the duration of the periods of increase and decrease) depends on the concentration and toxicity of the pollutants. Comparison of carp in fresh water and carp acclimated to 1.2% salt water indicates that there is greater sensitive to the pollutants under the influence of salt water. All responses are unspecific. Suggestions are given for the use of these tests as criteria for water quality. (Moore-IVI)
W84-01129

EFFECTS OF TEMPERATURE AND COLOR COMPONENTS OF WASTEWATER DISCHARGES ON AQUATIC COMMUNITIES,
Westvaco Corp., Covington, VA.
T. G. Botkins, Jr.
Tappi Journal, Vol. 66, No. 3, p 107-110, March, 1983. 5 Fig, 1 Tab.

Descriptors: *Thermal pollution, *Color, *Pulp wastes, Water pollution effects, Effluents, Industrial wastes, Aquatic life, Simulation, Model studies, Cooling water, Stream discharge, Fish, Bass, Jackson River, Virginia.

Westvaco operates a bleached kraft and semi-chemical pulp and paper mill and an activated carbon plant in Covington, Virginia. Process and cooling-water effluents from the facility are discharged into the Jackson River. A thermal discharge demonstration was conducted to evaluate the effects of temperature and color components of the discharges on aquatic communities. The study included: modeling to simulate stream flows and temperatures, an evaluation of the thermal tolerance limits of fish and supportive tropic levels, and the execution of bioassays to assess the joint effect of temperature and color on smallmouth bass. It was concluded that mill effluents would not cause an imbalance of the indigenous aquatic communities. (Moore-IVI)
W84-01164

SORPTION OF POLYCHLORINATED BIPHENYLS (PCB) TO CLAY PARTICULATES AND EFFECTS OF DESORPTION ON PHYTOPLANKTON,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
G. M. Nau-Ritter, and C. F. Wurster.
Water Research, Vol. 17, No. 4. p 383-387, April, 1983. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Polychlorinated biphenyls, *Clays, *Sorption, *Phytoplankton, Illite, Chlorite, Water pollution effects.

The sorption of polychlorinated biphenyls (PCB) on illite and chlorite, two minerals of defined comparison, was investigated. Illite particles adsorbed higher C-14 PCB (Aroclor 1254) concentrations than did chlorite particles with equilibrium concentration factors between particles and water being 1.4 x 0.0001 for illite and 1.0 x 0.0001 for chlorite. Desorbed PCB inhibited photosynthesis and reduced chlorophyll-a content of natural phytoplankton assemblages within dialysis membrane bags suspended in the water of a tidal marsh. There was no significant difference in effects on the phytoplankton of PCB desorbed from the two minerals. The rate of C-14 PCB desorption was dependent on the initial concentration on the clay particles. The rate of C-14 PCB loss from bags with particles was slower than that from bags without particles. (Author's abstract)
W84-01262

THE INFLUENCE OF SPRING AND FALL TEMPERATURES ON THE AVOIDANCE RESPONSE OF JUVENILE ATLANTIC MENHADEN, BREVOORTIA TYRANNUS, EXPOSED TO SIMULTANEOUS CHLORINE-DELTA T CONDITIONS,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
L. W. Hall Jr., D. T. Burton, S. T. Margrey, and W. C. Graves.
Water Resources Bulletin, Vol. 19, No. 2, p 283-287, April, 1983. 2 Fig, 2 Tab, 25 Ref.

Descriptors: *Power plants, *Menhaden, *Chlorine, *Temperature effects, Fish behavior, Avoidance, Environmental effects, Chlorination, Cooling water, Effluent, Residual chlorine, Acclimation.

The avoidance response of groups of juvenile Atlantic menhaden, Brevoortia tyrannus, was evaluated by exposing test species to a range of simultaneous total residual chlorine (TRC) (0.00, 0.05, 0.10, and 0.15 mg/L) and elevated temperature (0, 2, 4, and 6 C) conditions simulating power plant discharges. This species was tested at both 15 and 20 C to determine possible effects of acclimation temperature on the avoidance response. These temperatures were selected to represent spring or fall thermal conditions when most East Coast power plant facilities initiate power plant chlorination in the spring or terminate the use of this biocide in the fall. An unbalanced 3-factor factorial design was used to develop response surface avoidance models at 15 and 20 C. The model developed at 15 C showed: (1) an increase in avoidance occurred at all delta T conditions as TRC increased from 0.00 to 0.05 mg/L; (2) a greater degree of avoidance occurred at TRC concentrations above 0.05 mg/L at all delta T conditions; and (3) TRC was the most important term influencing avoidance. There was a significant difference ($p<0.00001$) between avoidance models at 15 and 20 C. However, when extreme conditions of 0.15 mg/L TRC and 0-6 C T were compared, the degree of avoidance responses (percent time in control area) was similar. (Author's abstract)
W84-01275

DISSIPATION OF 2,4-D DMA AND BEE FROM WATER, MUD AND FISH AT LAKE SEMINOLE, GEORGIA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. E. Hoeppel, and H. E. Westerdahl.
Water Resources Bulletin, Vol. 19, No. 2, p 197-204, April, 1983. 2 Fig, 2 Tab, 42 Ref.

Descriptors: *Dissolved oxygen, *Herbicides, *Water pollution effects, Pesticides, Acidity, Lakes, 2,4-D, Lake Seminole, Georgia, Myriophyllum.

Dense watermilfoil beds of Lake Seminole, Georgia were treated with either 2,4-D dimethylamine (DMA) or 2,4-D bisoxyethanol ester (BEE) at rates of 22.5 and 45 kg a.e./ha. Rapid conversion of both formulations to the 2,4-D acid form was observed with no detection of either original compound in the water in less than 24 hrs after application. Maximum detected 2,4-D concentrations in the high rate, 2,4-D DMA and 2,4-D BEE plots were 3.6 and 0.68 mg/l, respectively. All but seven samples at a 2,4-D BEE plot showed non-detectable herbicide levels after 6 days and all water samples were below detectable limits by day 13. Potentially toxic transformation products such as dimethylnitrosamine and 2,4-dichlorophenol were not detected. No significant accumulation of 2,4-D was found in fish collected from sites treated with 2,4-D DMA. Sedimentation showed no significant accumulation of 2,4-D, 2,4-D BEE or 2,4-dichlorophenol. Small decreases in dissolved oxygen and pH, associated with the complete watermilfoil control in plots had returned to normal summer values by day 28. (Baker-IVI)
W84-01287

TOTAL MERCURY IN FISHES AND SELECTED BIOTA IN LAHONTAN RESERVOIR, NEVADA: 1981,
Nevada Univ. System, Reno. Bioresources Center.
J. J. Cooper.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 1, p 9-17, July, 1983. 3 Tab, 27 Ref. 14-34-0001-0271.

Descriptors: *Mercury, *Fish, *Biological magnification, Water pollution effects, Industrial wastes, Heavy metals, Bioaccumulation, Lahontan Reservoir, Nevada.

Lahontan Reservoir, located 72 km southeast of Reno, Nevada, receives the entire flow of the Carson River. Mercury was introduced into the Carson River during the mining of gold and silver in the Comstock Lode. During the summer of 1981 fish were collected for analysis using a variety of methods including gill netting, beach seining and dip netting. Results of cold vapor atomic absorption analysis indicate that significant mercury accumulation is occurring within fishes of Lahotan Reservoir. Mercury concentrations in muscle tissue collected from 11 species ranged from 0.11 mg/kg in young-of-the-year white bass to 9.52 mg/kg in a striped bass with a know residence time within the waterbody of 16 yr. Of 53 muscle tissue samples analyzed, 36 (68%) exceeded the 1 mg/kg action level. In general, mercury concentrations within species increased with fish weight. A significant difference was found between mean mercury concentration in omnivores (1.16 mg/kg) compared to second order piscivores (1.64 mg/kg) ($P<0.05$). Likewise, mean mercury concentrations of the second order piscivores were significantly lower than first order piscivores (3.39 mg/kg) ($P<0.001$). This suggests that biomagnification is occurring within the fishes of Lahontan Reservoir. (Moore-IVI)
W84-01292

EFFECTS OF TEMEPHOS ON THE RESPIRATORY RATE OF THE SALT MARSH AMPHIPOD, GAMMARUS MUCRONATUS,
Northeastern Univ., Boston, MA. Dept. of Biology.
E. Ruber, and K. LaFrance.
Bulletin of Enviromental Contamination and Toxicology, Vol. 31, No. 2, p 148-151, August, 1983. 1 Fig, 2 Tab, 6 Ref. RR07143.

Descriptors: *Toxicity, *Insecticides, Temephos, Amphipods, Environmental effects, Aquatic animals.

In order to determine whether overall changes in metabolic rate of amphipods can be detected at sublethal concentrations of insecticides and whether this could lead to predictions of mortality after 48-hr or longer, the amphipod Gammarus mucronatus was exposed to the organophosphate temephos. After exposure, the gammarids were removed to vials where oxygen concentration changes over 4-hr were measured. The reduction in oxygen concentration after exposure to 0.01 ppm temephos is not statistically significant, but the reduction after exposure to 0.1 ppm is. This shows significant respiratory inhibition at 24-hr at concentrations of insecticide which do not cause significant 24-hr mortality rates. With further refinements, this technique may be useful for impact analysis. (Moore-IVI)
W84-01296

CONCENTRATIONS OF UNSUBSTITUTED POLYCYCLIC AROMATIC HYDROCARBONS IN SOFTSHELL CLAMS FROM COOS BAY, OREGON, USA,
Oregon State Univ., Corvallis. Dept. of General Science.
M. C. Mix, and R. L. Schaffer.
Marine Pollution Bulletin, Vol. 14, No. 3, p 94-97, March, 1983. 2 Tab, 1 Fig. CR 808000-01-0.

Descriptors: *Polycyclic aromatic hydrocarbons, *Benzo(a)pyrene, *Clams, Monitoring, Water pollution, Estuaries, Hydrocarbons, Industrial plants, Bays, Oregon.

Concentrations of benzo(a)pyrene (BAP) were measured in subpopulations of softshell clams, Mya arenaria, from four intertidal sites in Coos Bay from June 1976 to June 1978. Subsequently, concentrations of 15 unsubstituted polynuclear aromatic hydrocarbons (PNAH) were determined in two subpopulations from September 1978 to August 1979. There were significant differences between BAP concentrations in clams from the four sites. For the two-year period, they were highest in clams inhabiting areas adjacent to the industrialized bayfront and lowest in clams inhabiting more remote areas. There were no significant seasonal variations in BAP concentrations during this period. During the 1978-79 study, the average total PNAH concentration in clams from the bayfront area was 555.1 microgram/kg compared to 76.3 microgram/kg for clams from a more remote environment. In general, PNAH concentrations were lowest in the fall-winter and highest during the spring-summer. It appears that the use of clams as indigenous monitors has significant merit, particularly in bays such as those in Oregon which are fresh-water dominated for extended periods of the year. The BAP and PNAH levels in clams from the four sites reflected the degree of development and industrialization and presumably, the level of contamination in the overlying water column. (Moore-IVI)
W84-01368

UPTAKE OF LEAD AND CHROMIUM BY PRIMARY PRODUCERS AND CONSUMERS IN A POLLUTED LAGOON,
Cagliari Univ. (Italy). Dept. of Pharmaceutical Chemistry and Toxicology.
W. Capone, C. Mascia, M. Porcu, and M. L. Tagliasacchi Masala.
Marine Pollution Bulletin, Vol. 14, No. 3, p 97-102, March, 1983. 3 Fig, 10 Tab, 6 Ref.

Descriptors: *Bioaccumulation, *Industrial wastes, *Lagoons, Water pollution effects, Petrochemicals, Oil industry, Crustaceans, Trophic levels, Sediments, Sardinia, Lead, Chromium.

Sediments, aquatic macrophytes and some species of crustacea taken from the S. Gilla lagoon in Sardinia were analyzed for possible concentrations of lead and chromium resulting from exposure to wastewater from urban centers and industrial plants and pollution from a nearby petrochemical plant. Among the Thallophyta tested, the highest values of bioaccumulation were found in Polysiphonia, which were totally absent from some sampling sites. In the Ruppia type a lead higher accumulation was noted in the radical apparatus and for chromium in the foliar one. The values of foliar bioconcentration for both metals do not change greatly with changes in the concentrations in the sediments. Among the Crustacea considered, the order of decreasing importance concerning bioconcentration for chromium and lead is Corpophium, Sphaeroma, Gammarus, and Idothea. The total lagoon mean values of transfer factors between the various crustacea and the seaweed which they usually consume show a tendency to acc
more chromium than lead. The exceptio
case of Sphaeroma could be explained
higher weight in its exoskeleton due to the
content. (Baker-IVI)
W84-01369

**MINE-DERIVED METAL POLLUTI
THE ISLE OF MAN,**
Liverpool Univ., Port Erin (England). I
Marine Biology.
T. Southgate, D. J. Slinn, and J. F. Easthan
Marine Pollution Bulletin, Vol. 14, No. 4
140, April, 1983. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Mollusks, *Mine drainage,
aries, Zinc, Lead, Copper, Cadmium, Se
Bioaccumulation, Mytilus, Scrobicularia,
metals, Harbors, Isle of Man.

The sediments of rivers draining areas
ming activity in the Isle of Man containe
ly enhanced levels of zinc, lead and, to
extent, copper and cadmium. This contan
extended into the estuarine harbors where
reflected in the metal content of four sp
bivalve mollusks. Of the latter, Mytilus ed
the most useful indicator species in that it o
in all five estuarine harbors but Scrob
plana, although of more limited distributio
centrated much higher levels of zinc an
Individual variation of metal levels was hig
species of bivalves examined; a negative
tion of dry weight:metal content was demo
in many cases, but other factors may also c
ute to such variation. (Author's abstract)
W84-01370

**EFFECTS OF LARGE FRESHWATER D
SIONS ON BENTHOS OF A MEDIT
NEAN LAGOON,**
Endoume Marine Station and Oceano
Centre, Marseille (France).
G. Stora, and A. Arnoux.
Estuaries, Vol. 6, No. 2, p 115-125, June,
Fig, 2 Tab, 15 Ref.

Descriptors: *Estuarine environment, *Wa
version, *Salinity, Hydroelectric plants, C
depletion, Sedimentation, Mollusks, La
Benthos, Marine animals, Etang de Berre, F

The Etang de Berre, located near Marseille
largest French Mediterranean lagoon. S
before and after commencement of operatio
hydroelectric plant have followed chan
marine benthic communities in response to
freshwater inflows diverted from the D
River. After several unstable years, the
benthic communities were replaced by a e
line and eurythermal assemblage and large a
the lagoon were devoid of macrobenthos
oxygen depletion. Analysis of the dynam
mollusk populations shows the importance o
tuations in freshwater discharges and resulti
linity variation, sedimentation, dissolved o
depletion and sediment pollutants. (Autho
stract)
W84-01377

**INDEX ASSOCIATED WITH NUTRIENT
TROPHICATION IN THE MARINE ENVI
MENT,**
Democritus Nuclear Research Center, A
(Greece).
M. Karydis, L. Ignatiades, and N. Moschopou
Estuarine, Coastal and Shelf Science, Vol. 1
3, p 339-344, March, 1983. 3 Fig, 3 Tab, 12

Descriptors: *Eutrophication, *Marine en
ment, *Nutrients, Phosphorus, Nitrogen, Effl
Wastewater pollution, Bays, Gulfs, Saronicos

The annual loadings and distributional patte
phosphorus and nitrogen were observed at s
stations in the Saronicos Gulf, Aegean Sea d
1980. All nutrient concentrations peaked shar
the northern part of the gulf where a se
outfalls exists. A nutrient eutrophication inde
devised with the following criteria: to be sp

ch nutrient; to take into account loading of
ea by the nutrient; to be dimensionless and
pplication to various types of water; to be
ve to stressful effects of eutrophication; and
imple for gathering data and for calculation.
trient eutrophication index (I) offers a rigor-
st of the degree of eutrophication at the
s on the Saronicos Gulf. The sensitivity of
lex implies that it can be used in most gulfs
nbayments enriched by sewage discharges
aracterized by strong environmental gradi-
Moore-IVI)
1388

EN CONSUMPTION IN THE SHRIMP, EMONETES PUGIO, EXPOSED TO TUATING TEMPERATURES AND FOOD AMINATED WITH THE DIAROMATIC OLEUM HYDROCARBON, DIMETHYL-THALENE,
a Inst. of Marine Science, Gloucester Point.
Dillon.
ne, Coastal and Shelf Science, Vol. 16, No.
03-413, April, 1983. 4 Fig, 1 Tab, 36 Ref.
AA-D-00025, NA80AA-D-00021.

otors: *Dimethylnaphthalene, *Toxicity,
p, *Oxygen requirements, Water tempera-
ydrocarbons, Oxygen concentration.

n consumption rates (VO2) in the grass
Palaemonetes pugio were determined after
y exposure to fluctuating temperatures (FT)
C) and/or dimethylnaphthalene (DMN)-
inated food (0.24 micro g DMN/g wet wt)
in after a 16 day recovery period of stable
atures (20 C) and uncontaminated food. In-
of DMN-contaminated food for 32 days
in elevated VO2 in shrimp exposed to
g oxygen concentrations. After the 32 day
re period, FT had no significant effect on
15, 20 and 25 C, tissue VO2 and VO2 in
g oxygen. Hemolymph copper concentra-
vere significantly depressed in shrimp ex-
o DMN-contaminated food. After the 16
covery period, shrimp from the FT regime
d depressed VO2 when exposed to 25 C
to 15 C. These depressed respiratory rates
ffset by the stimulatory effect of DMN-
inated food. These respiration studies were
ly unproductive in explaining the previous-
rted effects of FT and DMN-contaminated
n the survival of P. pugio under hypoxic
ons. (Author's abstract)
390

Waste Treatment Processes

SAY AND DOSE MEASUREMENT IN SINFECTION,
Carolina Univ. at Chapel Hill. Dept. of
nmental Sciences and Engineering.
Dualls, and J. D. Johnson.
l and Environmental Microbiology, Vol.
3, p 872-877, March, 1983. 6 Fig, 20 Ref.

otors: *Bioassay, *Disinfection, *Ultraviolet
n, *Wastewater treatment, Bacillus, Spores,
rough reactors, Multiple-lamp reactors,
a.

rison between various pilot and full-scale
ations of ultraviolet (UV) disinfections of
ater has been limited because there was no
method of measuring UV doses nor any
tiated method for calculating doses in the
x geometries and absorbing solutions within
l reactors. A bioassay method was devel-
measure the average intensity within a UV
tion reactor. The survival of spores of Ba-
ubtilis was determined as a function of UV
prepare a standard curve. Spores were
o unknown systems, and the survival rate
ed to determine the average intensity. A
ation was used for flow-through reactors
ch spores were injected as a spike and
ed at a known time after injection. A point
summation method for calculating intensity
rified by bioassay measurements in a simple cylinder. This method was also applied to multiple-lamp reactors. (Moore-IVI)
W84-01051

INFLUENCE OF SUBSTRATUM WETTABILITY ON ATTACHMENT OF FRESHWATER BACTERIA TO SOLID SURFACES,
Warwick Univ., Coventry (England). Dept. of Environmental Sciences.
J. H. Pringle, and M. Fletcher.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 811-817, March 1983. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Bacteria, *Substrates, *Wettability, *Deterioration, Corrosion, Clogging, Adhesion, Wastewater treatment.

Attachment of bacteria to surfaces of flowing systems such as pipelines ensures that the population is not eliminated by washout and may be the first stage in the deterioration of such structures through corrosion or clogging. Bacterial adhesion and growth on various substrata can have advantages in biotechnological processes such as waste treatment. The attachment of a number of freshwater bacteria from River Sowe, Coventry, England, to hydrophobic and hydrophilic surfaces was evaluated, and further studies evaluated the attachment of selected isolates to a number of substrata with a range of water wettabilities. The wettability of each substratum was determined by contact angle measurement and was expressed as the work of adhesion. No generic pattern of attachment to the test surfaces was found, although the majority of the organisms isolated showed a preference for the hydrophobic surface. A more detailed study of selected isolates showed a relationship between the work of adhesion and number of attached cells. Each bacterium attached in maximum numbers to a surface that was characteristic of that organism and that had a work of adhesion between 74 and 105 mJ/sq m. (Moore-IVI)
W84-01053

CHLORINE-INDUCED DAMAGE TO SURFACE ADHESIONS DURING SUBLETHAL INJURY OF ENTEROTOXIGENIC ESCHERICHIA COLI,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
S. M. Walsh, and G. K. Bissonnette.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 1060-1065, March 1983. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Escherichia coli, *Chlorination, *Fecal coliforms, *Pathogenic bacteria, Bacterial analysis, Indicators, Public health, Infection, Wastewater treatment.

The assessment of the sanitary quality of water may be complicated by the presence of sublethally injured fecal indicator organisms. A portion of the viable population may escape detection by most methods prescribed for the bacteriological examination of water. A comparison of the adhesive ability of noninjured and chlorine-injured enterotoxigenic E. coli was made by in vitro attachment to human peripheral leukocytes. Chlorination selected for noninjured cells with greater capabilities for colonizing the small intestine. Injured populations exhibited reduced association with leukocytes. The maximum reduction was seen in populations with greater than 80% injury. These cells demonstrated less adhesive ability than nonpiliated populations. Electron micrographs suggested that reduced adhesive ability was due to the loss of surface structures as a consequence of sublethal chlorination. The data implied a reduced ability among chlorine-injured pathogens to colonize the small intestine and initiate disease. (Moore-IVI)
W84-01054

MICROBIAL FOULING OF REVERSE-OSMOSIS MEMBRANES USED IN ADVANCED WASTEWATER TREATMENT TECHNOLOGY: CHEMICAL, BACTERIOLOGICAL, AND ULTRASTRUCTURAL ANALYSES,
California Univ., Irvine. Environmental Analysis Div.
H. F. Ridgway, A. Kelly, C. Justice, and B. H. Olson.
Applied and Environmental Microbiology, Vol. 45, No. 3, p. 1066-1084, March 1983. 13 Fig, 3 Tab, 35 Ref. Orange Co. Water Dist. contract 4107-160-81.

Descriptors: *Reverse osmosis, *Membrane processes, *Bacteria, Advanced wastewater treatment, Cellulose acetate membranes, Acinetobacter, Flavobacterium, Moraxella, Pseudomonas, Alcaligenes, Bacillus, Lactobacillus, Wastewater treatment, California, Orange County, Water Factory 21.

Biofouling of reverse-osmosis membranes was investigated at an advanced wastewater treatment facility. Cellulose diacetate membranes operated for approximately 4,000 hr became uniformly coated with a mucilaginous fouling layer. The fouling material was approximately 93% water by weight, and nearly 90% of the dehydrated residue was organic in composition. Calcium, phosphorus, sulfur, and chlorine were the major inorganic constituents detected. Protein and carbohydrate represented as much as 30 and 17%, respectively, of the dry weight of the biofilm. Bacteriological plate counts indicated up to 5,600,000 colony forming units/sq cm of membrane surface. Accumulation of (H3)glucose in the biofilm and measurement of ATP indicated that the fouling bacteria were metabolically active in situ. The genus Acinetobacter and the Flavobacterium-Moraxella group were the major generic groups associated with the feed-water surface of the membrane, whereas species of the generic groups Acinetobacter, Pseudomonas-Alcaligenes, and Bacillus-Lactobacillus predominated of the permeate water surface. Electron microscopy revealed that the biofilm on the feed-water surface of the membrane was 10 to 20 millimicrons thick and was composed of several layers of compacted bacterial cells, many of which were partially or completely autolyzed. The bacteria were firmly attached to the membrane surface by an extensive network of extracellular polymeric fibrils. Polyester (Texlon) support fibers located on the permeate surface of the reverse osmosis membranes were sparsely colonized, suggesting bacterial regrowth in the product water collection system. (Author's abstract)
W84-01057

PEROXIDASE-CATALYZED REMOVAL OF PHENOLS FROM COAL-CONVERSION WASTE WATERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science.
A. M. Klibanov, T.-M. Tu, and K. P. Scott.
Science, Vol. 221, No. 4607, p 259-261, July, 1983. 1 Fig, 19 Ref.

Descriptors: *Wastewater treatment, *Phenols, *Enzymes, Horseradish peroxidase, Hydrogen peroxide, Coal gasification, Degradation.

An enzymatic approach is described for the removal of phenols from coal conversion aqueous effluents. Upon addition of horseradish peroxidase and hydrogen peroxide, a solution containing phenol immediately turns brown and a precipitate forms gradually, a response not brought on by the use of either reagent alone. Removal efficiencies of 99% can be obtained. The treatment was examined in the practical range of phenol concentrations of from 0.01 to 5 g/liter (pH 9). A typical coal gasification waste water was also examined as it was expected to contain constituents that would adversely affect bacterial and other methods of dephenolization. The sample included: phenol, 2 g/l; ammonia, 5 g/l; chloride, 19 g/l; cyanide, 0.1 g/l; thiocyanate, 1 g/l; and had a pH of 9.0. When 2 units of peroxidase per ml and 2 mM of H_2O_2 were added to a 0.1 g/l of the test solution a removal efficiency of only 10% was achieved. In the absence of these additional contaminants a 99% removal efficiency had been noted. However, increasing the concentration of phenol to 2 g/l and the concentrations of peroxidase and H_2O_2 proportionally, the removal efficiency jumped to 97% as compared to a 98% removal efficiency for 2 g/l

phenol in the absence of other contaminants. This indicated that at high, significant phenol concentrations, the presence of contaminants is not an important factor to the operation of this method. Other experiments showed that pollutants such as polychlorinated biphenyls can be enzymatically coprecipitated with the phenols. One possible use of this dephenolization method would be to replace conventional bacterial degradation of phenols in open ponds. This new method would be much less sensitive than bacterial degradation to variations in pH, phenol concentration, other toxic pollutants, and temperature. (Baker-IVI)
W84-01085

CHEMICAL CLARIFICATION OF DREDGED MATERIAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
P. R. Schroeder, and F. D. Shields, Jr.
Journal of Environmental Engineering, Vol. 109, No. 2, p 414-427, April, 1983. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Clarification, *Wastewater treatment, *Dredged material, Effluent, Flocculation, Polymers, Costs, Containment area effluents, Sediments.

Dredged material may be disposed in diked containment areas instead of open water in order to reduce adverse impacts on the aquatic community and water quality and to allow productive use of the dewatered material. Laboratory and design procedures have been developed for chemical clarification of dredged material containment area effluents based on results of laboratory and field tests. The design is suitable for normal disposal operations including remote locations, high and variable flows and solids loadings, and temporary and intermittent operations. The treatment system requires minimal equipment and operations. Low viscosity, highly cationic liquid polymer is applied at the drainage structure of the primary containment cell. Mixing for dispersing polymer and flocculation is provided by turbulence of flow through the discharge culvert. A small secondary cell is used for settling and storage of treated material. Design parameters are determined by jar tests. Major cost components, are polymer, labor, and construction. The cost for equipment, labor, and polymer should range from $0.08/cu yd-0.25/cu yd ($0.10/cu m-0.33/cu m) (1981 dollars) of in situ sediment dredged and is dependent on the production rate, polymer dosage, and treatment system design. (Moore-IVI)
W84-01092

ANAEROBIC TREATMENT OF DILUTE WASTEWATERS USING AN UPFLOW SLUDGE BLANKET REACTOR,
Birmingham Univ. (England). Dept. of Civil Engineering.
C. F. Forster, and D. A. J. Wase.
Environmental Pollution (Series A), Vol. 31, No. 1, p 57-66, May, 1983. 3 Fig, 4 Tab, 17 Ref.

Descriptors: *Anaerobic digestion, *Upflow sludge blanket, *Industrial wastes, *Wastewater treatment, Food-processing wastes, Chemical wastes, Plug flow, Kinetics.

An anaerobic upflow sludge blanket (USB) reactor was used successfully to treat two effluents, a confectionery waste in which sugar was the main component, and a chemical waste of which the principle constituent was acetate, of much lower strengths than those hitherto reported as suitable for such a system. The confectionery waste was mixed with settled domestic sewage to achieve a predetermined strength, and nitrogen and phosphorus were added, in excess, to the acetate waste to ensure that these nutriments were not limiting. Analysis of the results indicated first-order kinetics and plug-flow characteristics within the reactor. Data for COD removal and gas yield showed that this system compared favorably with an anaerobic filter, and also suggested that the confectionery waste was in some way limited, or contained inhibitor, emphasizing a need for preliminary studies. (Moore-IVI)
W84-01114

CONFIRMED VIRUSES VERSUS UNCONFIRMED PLAQUES IN SEWAGE,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
J. J. Bertucci, S. H. Abid, C. Lue-Hing, C. S. Clark, and J. D. Fenters.
Journal of Environmental Engineering, Vol. 109, No. 2, p 351-368, April, 1983. 1 Fig, 11 Tab, 18 Ref. EPA grants R803643, 805003.

Descriptors: *Viruses, *Wastewater, *Wastewater analysis, Raw wastewater, Effluent, Public health, Wastewater treatment.

Ninety-two treated and untreated sewage samples from seven wastewater treatment plants in Chicago, Illinois, Memphis, Tennessee, and Cincinnati, Ohio were examined for their virus content. Concentrated and unconcentrated samples were plaque assayed in five different cell culture systems. The virus etiology of plaques was confirmed by passage in homologous cell fluid cultures. Including all plaques tested, only 16.5 % were confirmed as of viral origin. BGM cultures produced the greatest number of unconfirmable plaques. Confirmed virus concentrations for individual samples ranged from less than 0.2 to 80 plaque forming units (PFU)/l. Confirmed PFU's/l averaged 0.7 for raw sewage, 0.5 for preliminary effluents and were not detected in final effluents. A strong recommendation of this study is that the virus etiology of all environmentally derived plaques must be confirmed. (Author's abstract)
W84-01125

INTERMITTENT SHALLOW AERATION OF ANAEROBIC LAGOONS TREATING PIGGERY WASTES,
Animal Research Inst., Victoria (Australia).
M. J. Ginnivan, and P. J. Eason.
Effluent and Water Treatment Journal, Vol. 23, No. 3, p 101 and 103-104, March, 1983. 4 Tab, 8 Ref.

Descriptors: *Animal wastes, *Wastewater treatment, *Aeration, Odor control, Lagoons, Bacteria, Fecal coliforms, Hydrogen sulfide, Anaerobic lagoons, Aerated lagoons, Streptococci.

The effect of intermittent aeration on the degree of odor control and the level of organic pollutants and bacteria in effluents from aerated-anaerobic lagoons was investigated. Perspex columns were used to simulate anaerobic lagoon profiles and were either unaerated (A), aerated for 15 min. and unaerated for 15 min. (B), aerated continuously (C) or aerated for 120 min. and unaerated for 120 min. (D). The average hydraulic retention time was about 128 days. All columns were initially seeded with sludge from an established lagoon which had been treating piggery wastes for 5 years. The mean temperature in all treatments was about 21.0 C and the average pH values were 7.8, 8.2, 8.4, and 7.05 for treatments A, B, C, and D, respectively. All treatments effectively removed organic pollutants from the waste. BOD5 and volatile solids reductions were at least 87 and 83%, respectively. The continuously aerated treatment was the most efficient. The average dissolved oxygen levels in treatments B, C, and D were about 67, 92, and 63% of saturation. While percentage reductions of fecal coliforms and fecal streptococci were high, there were still considerable numbers of viable bacteria in the effluent. The H2S levels associated with the unaerated treatment were above the level reported to present odor problems. H2S levels associated with the aerated treatments were lower than the detection limit of 0.1 ppm due to the ability of the sulfide to be rapidly oxidized. The individual volatile fatty acid concentrations in all treated effluents were less than 0.01 g/l, with the exception of acetic acid in treatment A which was about 0.1 g/l. While waste treatment was effective in all systems considered, the continuously aerated system consistently gave slightly better results than other methods. (Baker-IVI)
W84-01126

WATER UTILITY COMPLIANCE WITH HAZARDOUS MATERIALS, SUBSTANCES AND WASTE REGULATIONS,
Connecticut Water Co., Clinton.
For primary bibliographic entry see Fie
W84-01159

EVAPORATOR CONDENSATES: PR NARY ESTIMATES OF CAPITAL ANNUAL COSTS FOR ANAEROBIC FE TATION TO METHANE,
Washington Univ., Seattle. Dept. of Chemi gineering.
P. D. Haggerty, B. Wines, and J. L. McCar
Tappi Journal, Vol. 66, No. 5, p 75-79, Ma
4 Fig, 4 Tab, 15 Ref.

Descriptors: *Pulp wastes, *Anaerobic di *Fermentation, *Costs, Capital costs, Op costs, Kraft mills, Sulfite liquors, Industrial Methane.

Although sulfite and kraft pulp mill eva condensates account for only 10-15% of th effluent volume from a pulp mill, they can sent 30-50% of the total biochemical demand because of their relatively high co volatile organic substances. The processing condensates to produce methane by anaero mentation is being studied, and preliminar mates of the capital ($1,500,000) and ($490,000/yr) costs associated with the pro of 3790 cu m (1,000,000 gal)/day are simi both condensates. The annual cost included for by-product methane production. (Auth stract)
W84-01166

BIOLOGICAL TREATABILITY OF PEN LOROPHENOL WASTEWATER,
Moore, Gardner and Associates, Inc., Rouge, LA.
M. Madden, and M. Tittlebaum.
Journal of Environmental Sciences and Vol. A18, No. 4, p 583-596, 1983. 1 Fig, 1 T Ref.

Descriptors: *Biological wastewater trea *Bacteria, Wood preservatives, Pentac phenol, Organic carbon, Chemical demand, Industrial wastewater, Phenols, Mi ganisms.

The use of mutant or specialized bacteria aerobic treatment system to reduce or st hazardous wastes associated with wood pre tives was investigated in a bench scale biol wastewater treatment system, using a pentac phenol wastewater (PCPWW) from a woo serving plant. The treatment efficiencies of a rally occurring microbial system, a comme available 'mutant' or specialized populatio combination of the two were studied while going acclimation to fullstrength PCPWW days. TOC and COD removals averaged les 35 %. The decay rates (k-rates) for the biological test systems were significantly than those typically associated with do wastewater. It appeared that the waste oil tained in the PCPWW significantly contribu the influent COD and TOC. No significant ences were observed in treatment effici measured as TOC and COD. (Moore-IVI)
W84-01184

REMOVAL OF NITROGEN AND PHOS RUS FROM WASTE WATER IN A WA HYACINTH-BASED TREATMENT SYSTE
Florida Univ., Gainesville.
T. A. De Busk, L. D. Williams, and J. H. Ryt
Journal of Environmental Quality, Vol. 12, N p 257-262, April-June, 1983. 3 Fig, 4 Tab, 17

Descriptors: *Nitrogen removal, *Phosphoru moval, *Biological wastewater treatment, * hyacinth, Detritus, Nutrients, Denitrifica Ponds.

The importance of waterhyacinth plant ma (living and detrital) as a sink for nitrogen (N phosphorous (P) was evaluated in a waste treatment system in south Florida. The treat system consisted of four ponds (0.1 ha each)

ants were harvested, and one pond (0.2 which plants were not harvested. Nitro- phosphorus were removed in the plant crop at higher rates in the harvested 52 and 115 mg/sq m/d, respectively) than n-harvested pond (55 and 15 mg/sq m/d, ely). However, immobilization of N and P detritus in the sediment was less in the l ponds (3 and 1% of standing crop as-, respectively) than in the non-harvested and 13% of standing crop assimilation). exception of N in the non-harvested imates of nutrient removal by the water- standing crop and detritus from 4 May-4 1 were similar (within 35 mg N or P /sq the observed nutrient removal from the ter. Denitrification accounted for 92% of noved from the non-harvested pond. On asis, approximately 2.4 times more N was by denitrification in the non-harvested an was assimilated by waterhyacinth n the harvested ponds (875 vs. 362 mg N/ Mean total N removal from the complete sulted in an 87% reduction, from 9.96 to L. Total P was reduced only 10%, from 23 mg/L. (Author's abstract)
91

A, SWEETCORN, AND WHEAT RE- S TO LONG-TERM APPLICATION OF PAL WASTE WATER TO CROPLAND,
te Univ., Logan. Dept. of Plant Science.
mpbell, R. W. Miller, J. H. Reynolds, and reeg.
f Environmental Quality, Vol. 12, No. 2, , April-June, 1983. 3 Fig, 9 Tab, 34 Ref.

ors: *Land disposal, *Wastewater irriga- tewater disposal, Semiarid lands, Alfalfa, heat, Sodium, Copper, Iron, Zinc, Phos- funicipal wastewater.

ctive of this study was to assess, over two seasons, the long-term effects of applying waste water on agricultural land under conditions on selected crops. Alfalfa o sativa L.) cv Ranger, sweetcorn (Zea cv Jubilee, and wheat (Triticum vulgare remont, were grown on land to which ter had been applied for > 15 y. Plants n effluent-irrigated sites had greater ates, dry weights, and yields than did own on irrigated control sites. Chemical for metals in plant parts showed that Na er in plants growing on the waste water reas Cu, Fe, and Zn were much higher in rvested on control sites. Metal concentra- erved in plant materials were below haz- vels reported in the literature. In general, cant, detrimental, long-term effects of ap- nicipal waste water on land under semi- itions were detected. In fact, available P creased in effluent-irrigated soils. (Au- tract)
94

RGANISMS AND HIGHER PLANTS STE WATER TREATMENT,
Space Technology Labs., NSTL Station,

lverton, R. C. McDonald, and W. R.

f Environmental Quality, Vol. 12, No. 2, , April-June, 1983. 3 Fig, 8 Tab, 15 Ref. D-X0740.

ors: *Biological wastewater treatment, al filters, *Microorganisms, *Aquatic eeds, Cattails, Rushes, Anaerobic diges- boo, Biological oxygen demand, Nitro- val, Filters.

periments were conducted to compare the ter treatment efficiencies of plant-free mi- ters with filters supporting the growth of ragmites communis), cattail (Typha lati- h (Juncus effusus), and bamboo (Bambusa). The experimental systems consisted of ponents in series. The first component was obic settling-digestion container. The as a 'nonaerated' trough filled with rocks, decreasing from large rocks (up to 7.5-cm diameter) at the bottom, to pea gravel (0.25-to 1.3-cm diameter) at the top. The plant-free microbial filter was equally effective in carbonaceous BOD5 (5-d biochemical O2 demand) removal. The vascular aquatic plant series enhanced ammonia removal, and consequently improved nitrogenous BOD5 removal. Under the conditions of these experiments, raw sewage with initial BOD5's of 100 mg/L can be upgraded to meet secondary standards with 6 h in component 1, and 6 h in a plant-free filter or filter using cattail, rush, or reed. When initial BOD5's are approximately 450 mg/L, 24 h in component 1, 29 h in a reed filter are required to meet secondary standards. Total N removal studies were conducted, which demonstrated that a reed system is capable of removing NO3-N and NH3-N simultaneously, probably through a common NO2-N intermediary, then to N2. Overall, the reed system was superior to all others evaluated in this research project. (Author's abstract)
W84-01195

BEHAVIOR OF CHROMIUM IN SOILS: V. FATE OF ORGANICALLY COMPLEXED CR(III) ADDED TO SOIL,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W84-01201

SYNOPTIC REVIEW OF SIGNIFICANT TREATMENT EFFECTS ON CONSENT DECREE PRIORITY POLLUTANTS,
Carollo (John) Engineers, Fountain Valley, CA.
J. E. Tiernan.
Journal of Environmental Health, Vol. 45, No. 6, p 276-282, May/June, 1983. 4 Tab, 63 Ref.

Descriptors: *Wastewater treatment, *Pollutants, *Chlorination, Carcinogens, Mutagens, Teratogens, Coagulation, Filtration, Sedimentation, Adsorption, Ozonation, Water treatment, Priority pollutants.

Recently, the list of 65 consent degree priority pollutants has been expanded to 129 more specific priority pollutants that have been assigned top priority for elimination from U.S. waterways. These pollutants are primarily carcinogens, mutagens, teratogens, and suspected carcinogens, and as such are of concern to environmental health professionals. To determine treatment process alternatives to conventional secondary treatment, which have the most significant effects on concentrations of the consent decree priority pollutants in water and wastewater, an extensive review of the literature was conducted. Five treatment processes which affected the greatest number and concentration of these pollutants were selected for summarizing. These processes are: lime coagulation, sedimentation, and sand or mixed media filtration; activated carbon adsorption; the EPA/Coast Guard Process for Toxic Spills; ozonation; and chlorination. It was determined that four of the five treatment processes could significantly reduce the concentrations of consent decree pollutants. However, chlorination, often legally required by state and public health agencies for surface drinking waters and for wastewaters, caused an increase in both the number and concentration of one-third of the priority pollutants. Pollutants not initially present in the water were produced from organic precursors, and pollutants already present were increased in concentration. (Moore-IVI)
W84-01205

MERCURY, A HAZARDOUS WASTE PROBLEM,
California State Univ., Fresno.
J. Weber.
Journal of Environmental Health, Vol. 45, No. 6, p 284-287, May/June, 1983. 16 Ref.

Descriptors: *Mercury, *Wastewater treatment, *Waste disposal, Heavy metals, Industrial wastes, Water pollution control, Land disposal.

Mercury, in all its chemical forms, is a known toxic substance. Historically mercury has been used in many areas such as art, medicine, industry and scientific research. Although the social benefits have been many, the environment has suffered from an increase in mercury levels due to careless disposal methods with resultant damage to humans and wildlife. Industrial contamination of the nation's waterways has necessitated the development of methods for removing mercury from industrial wastestreams. These methods include precipitation, ion exchange, adsorption on charcoal, solvent extraction and absorption with sulfides. The use of these procedures has reduced the amount of mercury going into the waterways significantly. Disposing of mercury in landfill sites can also be controlled using methods which will keep the mercury contained within solid leak-proof jackets of impervious clay formations. Handled with care, mercury is not a threat to humans or the environment. (Author's abstract)
W84-01206

THE EFFECT OF SUSPENDED SOLIDS IN WASTEWATER ON SOIL HYDRAULIC CONDUCTIVITY: I. SUSPENDED SOLIDS LABELLING METHOD,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
A. J. A. Vinten, U. Mingelgrin, and B. Yaron.
Soil Science Society of America Journal, Vol. 47, No. 3, p 402-407, May-June, 1983. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Suspended solids, *Land disposal, Wastewater disposal, Effluent, Radioactive tracers, DDT, Leaching, Soil physical properties, Mathematical models.

A method of labelling suspended solids in sewage effluent with C14-DDT (1,1,1, trichloro-2,2-bis(p-chlorophenyl)ethane) is presented. The method allows the vertical distribution of deposited solids in a soil, following leaching with effluent, to be determined. A simple physical model which describes transport of labelled suspension through the soil is developed. This enables the conditions necessary for successful utilization of the method to be defined. Procedures for the estimation of the parameters required for the model are presented and the application of the method is demonstrated for two soils. It is shown that the method for tracing the fate of suspended solids is valid, as long as the label is sufficiently strongly adsorbed on suspended solids. It is also required that the rate of desorption of label from suspended solids be low compared with the residence of mobile suspended solids in the soil. (Author's abstract)
W84-01252

THE EFFECT OF SUSPENDED SOLIDS IN WASTEWATER ON SOIL HYDRAULIC CONDUCTIVITY: II. VERTICAL DISTRIBUTION OF SUSPENDED SOLIDS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
A. J. A. Vinten, U. Mingelgrin, and B. Yaron.
Soil Science Society of America Journal, Vol. 47, No. 3, p 408-412, May-June, 1983. 6 Fig, 13 Ref.

Descriptors: *Suspended solids, *Wastewater disposal, *Wastewater irrigation, Effluent, Permeability coefficient, Land disposal, Soil surfaces, Leaching.

A method for labelling of suspended solids in sewage effluent is used to trace the distribution of deposited solids in three soils following leaching with effluent. This distribution is related to the effect of sewage effluent application on the soil hydraulic conductivity. A sand, a sandy loam, and a loessial silt loam were studied. The reduction in relative hydraulic conductivity was greatest for the silt loam. This was due to accumulation of solids at the soil surface. In the sand little deposition of solids in the soil and little change in hydraulic conductivity occurred. Results indicate that with proper management sewage effluent can be used for irrigation without causing problems due to lack of soil permeability. (Author's abstract)
W84-01253

EFFECT OF TEMPERATURE ON THE GROWTH OF MICROBIAL FILM IN A MODEL TRICKLING FILTER,
Ashikaga Inst. of Tech. (Japan). Dept. of Civil Engineering.
Y. Honda, and J. Matsumoto.
Water Resources Research, Vol. 17, No. 4, p 375-382, April, 1983. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Trickling filters, *Temperature effects, *Biological Wastewater treatment, Biological oxygen demand, Growth kinetics, Autolysis.

The daily weight change of a microbial film in a model filter after the start of synthetic feed application was observed and the effect of temperature of the growth of the film was studied. The rate of BOD removal, the rate at which SS was washed out, the yield coefficient and the autolysis coefficient were chosen as the factors related to the growth of the film and the effects of temperature on them were examined. The growth pattern of the film can be divided into the lag-phase, growth-phase and stationary-phase. The growth equation of the film in the growth-phase was obtained by assuming that the rates of BOD removal and SS washed out were constant. In order to evaluate the growth of the film at various temperatures, the growth capacity and the mean growth rate were defined. The growth capacity is the film weight at the stationary-phase and expresses the maximum weight to which the film can increase in a given filter. The growth capacity increased as the temperature fell. This is due to the autolysis coefficient which becomes lower at low temperatures. The period necessary to reach the stationary phase was shorter at high temperatures. The mean growth rate, which was defined as the rate when the film has reached half the growth capacity, was at its maximum at 15 C. (Author's abstract)
W84-01263

OIL REMOVAL FROM WATER IN PARALLEL PLATE GRAVITY-TYPE SEPARATORS,
Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
J. A. Zeevalkink, and J. J. Brunsmann.
Water Research, Vol. 17, No. 4, p 365-373, April, 1983. 9 Fig, 4 Tab, 15 Ref.

Descriptors: *Separation techniques, *Oil pollution, *Gravity flow, Wastewater treatment.

Aspects of oil removal by gravity separation in parallel plate separators have been investigated both theoretically and experimentally. Attention has been paid to the possible influence of retention time distribution, co- or countercurrent flow (in tilted plate separators) and to the effect of perforation of the plates. Perforation enables an easy removal of separated oil in horizontal plate separators. It appears that the overflow rate, related to the horizontal projection of the real plate area, determines the performance of a plate separator in all these cases. A residence time distribution will lower the separation efficiency only when it is caused by a velocity profile over the width of the tank or by an extremely unequal distribution of the influent over the plates. A tilted full plate separator and a horizontal perforated plate separator with the same overflow rate perform equally well as to separation efficiency; only secondary, practical reasons will determine the choice between either construction. (Author's abstract)
W84-01264

TESTING THE POTENTIAL OF AQUATIC PLANTS TO TREAT ABATTOIR EFFLUENT,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
C.M. Finlayson, and A. J. Chick.
Water Research, Vol. 17, No. 4, p 415-422, April, 1983. 3 Fig, 4 Tab, 32 Ref.

Descriptors: *Biological wastewater treatment, *Food-processing wastes, *Rooted aquatic plants, Cattails, Bulrushes, Phragmites, Trenches, Nutrient removal, Evapotranspiration, Oxygenation.

The potential of 3 genera of emergent aquatic plant species (Typha spp, Phragmites and Scirpus) to ameliorate effluent from a poultry abattoir was evaluated in an experimental trench system. Three plastic-lined trenches containing Typha (two species), Phragmites and Scirpus plants in a gravel substrate were constructed near the abattoir. Effluent was allowed to percolate, with retention times of 2.7 - 3.6 days, through the trenches. The quality of the inflowing and outflowing effluent was compared by a regular sampling program for suspended solids, conductivity, turbidity, pH, dissolved oxygen, Na, K, Cl, N and P concentrations. The importance of water loss by evapotranspiration was investigated. Comparing the inflow to outflow, each trench system successfully reduced the suspended solids (83-89%), turbidity (58-67%), total nitrogen (14-56%) and total phosphorus (37-61%) concentration of the effluent while maintaining an acceptable pH and in the case of the Phragmites and Scirpus systems oxygenating the anaerobic inflow. Conductivity increased in the Typha and Phragmites trenches. If a correction is made for water lost by evapotranspiration, the three experimental trench systems reduced the nitrogen (42-75%), phosphorus (68-79%), sodium (7-34%), potassium (9-56%) content of the effuent. The chloride content of the effluent in the Phragmites system was increased by 15% but was reduced by 31 and 53% in the Typha and Scirpus systems respectively. The results from this initial experiment give an indication of the relative abilities of the three plant systems to treat the wastewater from the abattoir. Of the three that containing the Scirpus was superior. (Author's abstract)
W84-01266

LIMITATIONS OF HEAVY METAL REMOVAL FROM WASTE WATER BY MEANS OF ALGAE,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
E. W. Becker.
Water Research, Vol. 17, No. 4, p 459-466, April, 1983. 5 Fig, 4 Tab, 2 Ref.

Descriptors: *Heavy metals, *Biological wastewater treatment, *Phytoplankton, *Bioaccumulation, Biomass, Algae, Cyanophyta, Mercury, Cadmium.

It has been suggested by several authors that heavy metals might be removed from aqueous systems by phytoplanktonic algae, whose high capacity for accumulating dissolved metals has previously been described. This paper shows, by comparing results obtained on accumulation factors and growth rates in different modes, that metal removal by means of algae is not feasible in practice. It was found that under optimum conditions in a static system the reduction of a given initial metal concentration by 50% requires approximately 14 days, while in a dynamic model a retention time of approximately 19 days is needed to achieve the same reduction. Finally, measurements of nitrogenase activity inhibition caused by various concentrations of mercury and cadmium demonstrate that nitrogen-fixing blue-green algae can be used for biological sewage treatment only at very low heavy metal concentrations in the medium. (Author's abstract)
W84-01267

MORE TO LEARN ABOUT DISINFECTION,
E. H. Bryan.
Water Engineering and Management, Vol. 130, No. 5, p 26-28, May, 1983. 2 Fig, 8 Ref.

Descriptors: *Sludge conditioning, *Disinfection, Wastewater treatment, Heat treatment, Electron beam, Bacteria, Pasteurization, Irradiation, Chlorination.

An inportant objective of wastewater treatment and sludge management is to reduce the content of pathogenic organisms to levels at which the risk associated with final release to the environment is reasonable and acceptable. The latest developments in the disinfection process for use by the wastewater industry are reviewed. Most of the known physical, chemical and biological agents that are capable of inactivating pathogenic organisms in water or wastewater are of little or no value for disinfection of sludges. Processes that have been shown effective for disinfecti sludges include heat pasteurization, treatmen excess lime, and irradiation with gamma ra energized electrons. An experimental full-scal using cobalt-60 as the source of gamma rad has been in operation for more than 7 yr in Germany. Research on the use of energized trons for sludge disinfection is underway. The ibility of using sludges in the production of led to a full scale test. The high temperatur several days of residence time within the kiln plant resulted in combustion of all organic m present in the sludge and the formation of a s product with the ash residue fixed within a ce matrix. During the past decade, the use of chl for disinfection of water and wastewater has subjected to increasing concern about pot risks associated with by-products of its use. (B IVI)
W84-01324

THE TRICKLING FILTER FINDS A N PARTNER,
Brown and Caldwell, Walnut Creek, CA.
R. C. Fedotoff.
Water Engineering and Management, Vol. No. 6, p 28-31 and 52, June, 1983. 1 Fig, 3

Descriptors: *Trickling filters, *Design crit Wastewater treatment, Filters, Filtration, C fiers.

After extensive evaluation, the trickling fi solids contact wastewater treatment process demonstrated great potential for future use. process developed out of experimentation cond ed at the Corvallis Wastewater Reclamation P where it involves primary sedimentation, two c ventional rock-media trickling filters, and an ated channel that carries wastewater to two cially designed secondary clarifiers with cen well flocculation chambers. Gentle stirring in t chambers increases the aggregation of finely di ed solids into heavy flow. This floc settles quic to the bottom of the clarifiers and is removed sludge. Part of the sludge is returned to the aer contact channel, mixed with the trickling fi effluent and recirculated to the clarifiers. The mainder of the sludge is pumped to the prim sedimentation tank as waste. The process functi effectively wherever the trickling filter proces applicable, largely because of the flexibility m possible by tradeoffs in the design of its com nents. An initial design consideration is the size the trickling filter which governs the quality of wastewater entering the aeration system. Variat that give the process additional flexibility are size and residence times in the aerated contact a the return sludge aeration tanks. (Baker-IVI)
W84-01328

SEWAGE TREATMENT PROCESSES - TH SOLUTION TO THE ODOUR PROBLEM,
Mather and Platt Anti-Pollution Systems Lt Burgess Hill (England).
R. Anderson.
Water Services, Vol. 87, No. 1046, p 163-1 April, 1983. 2 Fig, 4 Tab.

Descriptors: *Ozonation, *Odor contro *Wastewater treatment, Ozone, Wet oxidati process, Disinfection, Water treatment odors.

The nature of the solution to odor problems e countered in the treatment of sewage may often found in a deeper understanding of the compl nature of the problem. Such matters as the dilutio factor and odor emission values must be measur and determined. The capital cost of any od abatement system is to a large extent dependant o the air flow involved. Extraction rates should b kept to the minimum sufficient to not only preve leakage of odors but also to prevent potential dangerous conditions from occurring As an exam ple of a method of abatement the wet oxidatio process is considered. The use of ozone durin sewage treatment reduces both the amines an sulfur compounds and further reduces them afte scrubbing. In addition to the odor problem, there also the problem of pollution by microbiologica contamination of the environment around a sewag

ent works. The ozone wet oxidation process able to remove a large proportion of the iological contamination collected through tion systems in enclosed plants. (Baker-IVI)
1334

ETHRIN TRIALS IN THE MELTHAM GE CATCHMENT AREA,
ire Water Authority (England).
odhead.
Services, Vol. 87, No. 1047, p 198-202, May,
Fig, 7 Tab, 10 Ref.

otors: *Pesticides, *Industrial wastes, pollution effects, Water pollution control, c life, England, Fish, Permethrin, Moth-g.

mothproofer based on the synthetic pyreth-rmethrin has become available. While this l is biodegradable, permethrin is also ex-toxic to fish and aquatic insects. Trials onducted at a large commission dyer and on the Meltham, England sewage catch-uring which permethrin was used in place rphenylid and dieldrin for two months. The of the sewage works effluent appeared not riorate as a result of permethrin use, but the ology was affected. Slime began to build up levels on certain of the primary filters. The of the receiving stream already affected sly by chlorphenylid and dieldrin was to deteriorate further. Fish could not be ive in the streamwater. Previously noted s in the vicinity of the dyeworks were ed both chemically in sediments and by cal changes. The situation at Meltham with to the mothproofing process is the most in Yorkshire with continued mothproofing ing levels promising to increase an already biological status in the receiving stream. A te change over to permethrin will almost y restrict damage to the Mag Brook system demand for mothproofing increases signifi-An additional benefit will accrue from such e in respect of sludge disposal options, but nge from organochlorine compounds in the ent will need to be complete. (Baker-IVI)
335

IQUE OPPORTUNITY TO UPGRADE R/WASTEWATER SYSTEMS,
Dresser and McKee, Inc., New York.
g, and D. Laredo.
ing Engineer, Vol. 61, No. 3, p 75-79, Sep-1983. 1 Fig.

otors: *Wastewater facilities, *Water con-e, *Water treatment, *Utilities, Mainte-Budgeting, Planning, Political constraints, alysis.

w awareness of the deterioration of the ucture calls for a fresh approach which nds mere repair or replacement. The under-remise of this approach is that water and ater utilities must be reliable, productive, ofitable. The conventional tools of manage-the appreciation of innovations in planning dgeting, tight administration, new technol-d effective communications - are sufficient ement this approach. A fundamental first planning any program for a system upgrad-comprehensive inventory of facilities. This be followed by an assessment of the status litions of the facilities, and how they relate gency's mission. The next step is program g, which should consist of a realistic ap-of what can be accomplished within the constraints and political milieu of the mu-y. The third step is to include infrastruc-grading into the agency's capital improve-rocess. Failures in a system should be diag-and a cost-effective, systematic plan of res-should be adopted. It is a self-defeating o repair breaks in the system as they occur. nfrastructure is treated as a whole, its resto-vill last longer, serve better, and in the long ess costly. (Moore-IVI)
336

THEORY OF CLARIFIER OPERATION. VI. THE PRECIPITATION PROCESS IN REACTOR-CLARIFIERS,
Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
R. M. Strang, K. B. Schnelle, Jr., and D. J. Wilson.
Separation Science and Technology, Vol. 18, No. 3, p 253-291, 1983. 23 Fig, 5 Tab, 19 Ref.

Descriptors: *Clarifiers, *Wastewater treatment, Metal-finishing wastes, Settling velocity, Chemical treatment, Flocculation, Mixing, Ferric hydroxide, Mathematical models.

Reactor-clarifiers are widely used for removal of metals from metal finishing wastewaters. They are similar to standard upflow clarifiers except that the addition of chemicals and the precipitation of solids takes place within the clarifier. A mathematical model is developed for the effect of the rapid-mix step on floc settling velocity in reactor clarifier operation. Data on ferric hydroxide flocs are consistent with the model. The most important parameter is the duration of the rapid-mix step; the longer this is, the more slowly does the floc settle. This is thought to be due to the finite rate at which the precipitation reaction causes the supersaturated solution to decay to equilibrium. There is a possibility of improving the performance of upflow clarifiers by bypassing a small fraction of the influent around the precipitator and introducing it, with mixing, at the entrance to the clarifier. Preliminary pilot scale studies on this look promising. (Moore-IVI)
W84-01365

5E. Ultimate Disposal Of Wastes

NEPTUNIUM AND AMERICIUM SPECIATION IN SELECTED BASALT, GRANITE, SHALE, AND TUFF GROUND WATERS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W84-01086

CONFIRMED VIRUSES VERSUS UNCONFIRMED PLAQUES IN SEWAGE,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
For primary bibliographic entry see Field 5D.
W84-01125

MINNESOTA'S HAZARDOUS WASTE SITING CRITERIA,
Minnesota Waste Management Board, Crystal.
For primary bibliographic entry see Field 5G.
W84-01146

GROUND-WATER MOUNDING DUE TO ON-SITE SEWAGE DISPOSAL,
Santa Clara Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W84-01154

SIGNIFICANCE OF ATP IN THE SETTLEMENT OF ACTIVATED SLUDGE,
Birmingham Univ. (England). Dept. of Civil Engineering.
A. R. Clarke, and C. F. Forster.
Journal of Chemical Technology and Biotechnology, Vol. 33B, No. 2, p 127-135, June, 1983. 7 Fig, 27 Ref.

Descriptors: *Sludge drying, *Adenosine triphosphate, Activated sludge process, Sludge volume index, Wastewater treatment, Settleable solids, Model studies, Sludge.

The settleability of sludge in relation to its adenosine triphosphate (ATP) concentration was examined using a laboratory-scale activated sludge plant for the treatment of simulated coke oven liquors. Throughout the test the average flow rate was maintained at 2.23 liters/day and the mixed liquor solids at 3.9 grams/liter. The feed-stock contained phenol and thiocyanate as the carbonaceous substrate. Standard analytical procedures were employed. A model describing sludge settlement was derived, based on the concept that the Mohlman or Sludge Volume Index (SVI) is the summation of the individual component settlement indices and that these are dependent on the individual microbial activities as measured in terms of the ATP concentration. Data to validate the model were obtained from a continuous 40 day period of operation during which time the sludge exhibited a series of settlement characteristics with SVI values ranging from 65 to 270. At very high SVI values it was necessary to add small quantities of silicone anti-foam to prevent the sludge buoying in the settlement tank and thereby creating problems of inadequate solids recycling and sludge losses. A linear correlation was supported between the SVI and the mass of ATP per unit mass of sludge solids. Thus, variations in the settlement characteristics of activated sludge, measured in terms of the SVI, can be explained in terms of ATP-activity of the sludge solids and conventional Monod kinetics. (Baker-IVI)
W84-01167

CHARACTERISTICS OF COMBINED EFFLUENT TREATMENT SLUDGES FROM SEVERAL TYPES OF PULP AND PAPER MILLS,
Wisconsin Univ.-Madison.
J. N. McGovern, J. G. Berbee, J. G. Bockheim, and A. J. Baker.
Tappi Journal, Vol. 66, No. 3, p 115-118, March, 1983. 1 Fig, 5 Tab, 11 Ref.

Descriptors: *Sludge disposal, *Pulp wastes, Pulp and paper industry, Industrial wastes, Effluent, Sludge composition, Wastewater treatment, Heavy metals, Nutrients, Wisconsin River.

Combined sludges from 7 primary-secondary effluent treatment systems serving 10 highly diversified pulp and paper operations on the Upper Wisconsin River were analyzed for total solids, carbohydrates, ash, and elemental composition, including plant nutrients and heavy metals. The 7 treatment plants serve 7 integrated wood pulp mills, an integrated recycling mill, a nonintegrated paper mill with a recycling paperboard operation, and a kraft-wood pulp mill. The total daily production of combined sludges from the 7 treatment plants in early 1980 was 199 metric tons. The characteristics of the 7 sludges varied several- fold with pulping and papermaking processes and operations and effluent treatment. Balances were developed between wood and process chemical elements and those elements of the sludges. The suitability of the sludges for land spreading and incineration is considered. (Moore-IVI)
W84-01186

SORPTION AND RELEASE OF CADMIUM BY SOME SEWAGE SLUDGES,
R. Riffaldi, R. Levi-Minzi, A. Saviozzi, and M. Tropea.
Journal of Environmental Quality, Vol. 12, No. 2, p 253-256, April-June, 1983. 1 Fig, 6 Tab, 24 Ref.

Descriptors: *Cadmium, *Sludge, *Adsorption, Fulvic acids, Cation exchange, Langmuir equation, Bonding.

Sorption and release of Cd were determined in nine sewage sludges from Tuscany, Italy. The Cd adsorption data were in agreement with both the linear sorption isotherm and the Langmuir equation. The average of calculated adsorption maxima was about 50% of the mean CEC value, indicating that exchangeable cations present in the sludges were more effective in competing with the Cd ion for exchange sites. The calculated Langmuir adsorption maxima were found significantly correlated with fulvic acid C content and carboxyl and phenolic hydroxyl groups of fulvic acids. The release of Cd retained at two initial concentrations as a function of different extraction solutions was indicated. Extraction experiments showed that Cd may be held in sludges by more than one type of site and that the strength of bonding decreases as the total Cd increases. Cadmium was retained mainly by exchange and complexing sites, the former assuming a relatively more important role as cadmium adsorption increased. The effect of

different exchangeable cations on the sorption of Cd by sludges was also studied. The amounts of Cd sorbed on the sludge surfaces decreased in the order: Ca-sludge > untreated sludge > Fe-sludge = Al-sludge. (Author's abstract)
W84-01192

BEHAVIOR OF CHROMIUM IN SOILS: V. FATE OF ORGANICALLY COMPLEXED CR(III) ADDED TO SOIL,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
B. R. James, and R. J. Bartlett.
Journal of Environmental Quality, Vol. 12, No. 2, p 169-172, April-June, 1983. 6 Fig, 9 Ref.

Descriptors: *Chromium, *Solubility, *Land disposal, *Sludge disposal, *Wastewater disposal, Organic acids, Heavy metals, Soil contamination.

Organically complexed Cr(III) added to soils may remain soluble, whereas the free Cr(III) metal ion would quickly become adsorbed and/or hydrolyzed and precipitated in the absence of soluble, complexing ligands. To separate these two phenomena, a laboratory procedure was developed to simulate the disposal of Cr(III)-containing organic wastes in soils, and to investigate the solubilities of organic complexes of this heavy metal after addition to soil. The method involves adding Cr(N3)3 to solutions of organic ligands adjusted to a pH between 3 and 8 to form inorganic hydrolyzed species and organic complexes at each pH. After measuring soluble Cr vs. pH, moist soil is added to bring the pH of each Cr-ligand system to 6.5-7.0, thereby precipitating uncomplexed, inorganic Cr(III), and labile Cr(III)-organic complexes. Subtracting Cr(VI) formed from total soluble Cr in the soil suspension gives a relative measure of organically complexed Cr(III) originally present in the aqueous systems at each pH. Citric acid, diethylenetriaminepentaacetic acid (DTPA), fulvic acids, and water-soluble organic matter from air-dried soil kept Cr(III) in solution above pH 5.5, and prevented its immediate removal by soil. Added Cr-citrate remained soluble for at least 1 y in limed samples of an Ultic Hapludalf Ap horizon incubated at field capacity moisture. Because organic acids similar to those studied here may be found in sewage sludge, animal manures, and industrial wastewater, these results should be useful in predicting the fate of Cr(III) added to soils amended with such wastes. (Author's abstract)
W84-01201

SLUDGE DISINFECTED WITH ELECTRON BEAMS,
Ion Physics Corp., Burlington, MA.
J. Morgan.
Water Engineering and Management, Vol. 130, No. 5, p 27-28, May, 1983.

Descriptors: *Sludge conditioning, *Electron beams, *Disinfection, Sludge disposal, Liquid sludge.

Electron beam disinfection was shown to be not only feasible, but also cost-effective for treating municipal sludge. Liquid sludge flows in a vertical free fall as a thin curtain a little over 4 ft wide. As it falls, the sheet of sludge is exposed to a beam of electrons energized by 1.5 million volts with a power of 75 kw. Disinfection takes place in the fiftieth of a second that it takes the sludge to fall through the scanning electron beam. Dosage levels are about 400 krads which raises the temperature of the water only 1 degree C, but reduces the total bacterial count by four or five orders of magnitude. After electron exposure is completed, the effluent line is sampled by a system. The sample plunger extends forward into the process line and pauses. It then withdraws a precise sample regardless of changes in line pressure or other parameters. This final checkpoint assures that the pathogen level of outgoing effluent is below the EPA limit. It also permits analyses of the sludge for water soluble compounds of such metals as cadmium, chromium, copper and lead. At current rates the disinfection of 1,000 gal of liquid sludge, treated with a 400 krad electron dosage requires about 20 kwh of power and costs about $4.00. For sludge containing 4% solids, this is equivalent to about $24.00 per ton of dry material. (Baker-IVI)
W84-01326

5F. Water Treatment and Quality Alteration

CONCENTRATION OF SIMIAN ROTAVIRUS SA-11 FROM TAP WATER BY MEMBRANE FILTRATION AND ORGANIC FLOCCULATION,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass, and R. Armon.
Applied and Environmental Microbiology, Vol. 45, No. 3, p 850-855, March, 1983. 1 Fig, 7 Tab, 19 Ref. EPA grant R 806588010.

Descriptors: *Rotaviruses, *Drinking water, *Membrane filters, *Flocculation, Viruses, Water analysis, Public health, Microporous filters, Water treatment.

Rotaviruses are viral agents of gastroenteritis in animals and humans. For determination of the extent of contamination of the environment with these viruses it is essential to have a reliable and sensitive technique for their detection. Most methods of virus concentration have been developed with poliovirus as a representative virus, but this virus differs from rotavirus in many characteristics, including adsorptive behavior and stability. Because simian rotavirus SA-11 resembles the human rotavirus, it is useful as a model for the human disease agents. Two types of filters were compared for their ability to concentrate this virus. Both Zeta Plus 60S and Cox AA type M-780 filters were efficient for virus adsorption, but the efficiency of virus elution was higher with Zeta Plus than with Cox filters. Optimum conditions for virus recovery from Zeta Plus filters included an input water pH of 6.5 to 7.5 and the use of 3% beef extract (pH 9.0) for elution. Under these conditions, an average of 62 to 100% of the virus was recovered in the concentrate. Organic flocculation was used as a second-step concentration method, with average recoveries of 47 to 69%. When the two methods were used to concentrate small numbers (7 to 75 plaque forming units/liter) of input rotavirus, an average of 75 + or - 40% recovery was achieved. With large volumes of input water, recovery was reduced to 16 + or - 7%. (Moore-IVI)
W84-01052

MOUNT ST. HELENS ERUPTIVE IMPACTS TO THE TOUTLE COMMUNITY GROUNDWATER SUPPLY,
Sweet, Edwards and Associates, Inc., Kelso, WA.
H. R. Sweet, and J. E. Edwards.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 2, p 145-150, May 1983. 4 Fig, 3 Ref.

Descriptors: *Groundwater pollution, *Mt. St. Helens, *Volcanoes, *Water supply development, Phenols, Iron, Taste, Odors, Well yield, Washington, Toutle.

The town of Toutle, approximately 26 mi northwest of Mount St. Helens, has utilized a shallow, high capacity well completed in recent alluvium of the South Toutle River for its water supply since 1974. Debris and mudflow following the May 18, 1980 eruption buried the well and the nearby treatment facility. The town immediately went on water rationing, and tank trucks were employed to haul water to the Toutle Reservoir. Reconnaissance field work showed inadequate stream base flow and no reservoir sites as well as poor infiltration gallery sites along Outlet Creek. Two test wells were drilled on the South Toutle bridge abutment near the old well. Drawdown/recovery tests showed either well capable of producing the necessary sustained yield of 200 gpm. Toutle residents soon complained of an objectionable water taste and medicinal odor. Testing showed the presence of up to 80 micrograms/l total phenols. Phenolic compounds are derived from decaying vegetation, and slow dewatering of the mudflow and debris materials into the underlying alluvium accounted for the microconcentrations of p
Field location of existing wells, a resistivity
and short aquifer tests were conducted
upper terrace adjacent to Toutle. Two terra
wells encountered interbedded terrace laha
alluvium. During drawndown/recovery
ground water with phenol concentrations o
15 micrograms/l was recovered. Drill c
show fibrous materials similar to the May 1
mudflow and these phenols are also believed
derived from the much older organics in the
tocene lahars. The high operation and mainte
costs of iron and phenol removal indicate th
mi pipeline to transmit water from the C
River is the best water supply alternative.
thor's abstract)
W84-01058

TREATABILITY OF WATER,
Univ. Coll., London (England). Dept. of Civ
Municipal Engineering.
K. J. Ives.
Journal of the Institution of Water Enginee
Scientists, Vol. 37, No. 2, p 151-164, April, 1
Fig, 5 Tab, 17 Ref.

Descriptors: *Water treatment, *Water an
Pilot plants, Water quality, Feasibility st
Water treatment facilities.

The first phase of proceeding towards desig
waterworks is analysis, which often has
linked with hydrological investigations, to
variability of water quality with season and
flow conditions. Although analysis of wate
provide some clues to its treatability, some
testing is required to establish feasible metho
treatment. Bench scale tests are used to bridg
gap between the laboratory analysis and pilot
operations; they may also be used in waterw
operation to provide rapid assessment of
changes that may be required in treatment.
next stage is pilot plant testing, which is best
on-site. The scaling criteria are often unce
even from pilot scale, and the chemical engi
ing unit operations approach is to be recomm
ed. (Moore-IVI)
W84-01073

**ENSURING WATER QUALITY IN A DIS
BUTION SYSTEM,**
East Bay Municipal Utility District, Oakland,
K. B. Stinson, and K. E. Carns.
Journal of Environmental Engineering, Vol.
No. 2, p 289-304, April, 1983. 1 Fig, 11 Tab, 6

Descriptors: *Coatings, *Odors, *Taste, *
forms, *Water conveyance, *Water quality, S
age tanks, Tetrachloroethylene, Gasoline, Con
ance structures, Drinking water, Organole
properties, Corrosion control, Pipes, Particu
matter, Asbestos.

The East Bay Municipal Utility Dis
(EBMUD) has evaluated and resolved several
zling distribution system water quality conc
which periodically plague most water utilities.
cessive coliform growths, complaints of medic
tastes and odors, and tetrachloroethylene foun
treated waters were all traced to different synth
organic coatings used to protect the interior
faces of steel storage tanks. After the repea
failure of several attempts to eliminate these p
lems, the coatings were removed and repla
Procedures for approving all new coatings w
developed. Complaints of petroleum and gaso
taste and odors were demonstrated to be due to
gasoline permeability of polybutylene and polye
ylene service laterals. Copper service laterals
now used as a substitute when needed. The
trict's gas chromatograph made it possible to so
some of these frustrating mysteries. Although
use of probes, coupons, and chemical indices
helpful in evaluating corrosion problems, the D
trict determined that there is no substitute for
physical inspection of the system. The use o
particle counter and a transmission electron mic
scope was instrumental in determining the effe
of corrosion control practices on particulate a
asbestos levels in distributed waters. (Author's
stract)
W84-01124

ACHLOROETHYLENE (TCE) CONCEN-
ON REDUCTION IN VINYL-LINED AS-
S CEMENT WATER MAINS THROUGH
APPLICATION OF CEMENT MORTAR
GS,
nd Ward, Inc., Waltham, MA.
uskus.
of the New England Water Works Associ-
ol. 97, No. 2, p 90-113, June, 1983. 13 Fig.

tors: *Water quality control, *Pipelines,
hloroethylene, Asbestos cement, Vinyl,
, Drinking water, Water pollution sources,
ated hydrocarbons.

were made in Ashland, Massachusetts to
aching of tetrachloroethylene (TCE) into
al water distribution systems which had
nstructed using vinyl lined asbestos cement
C) water pipes. The vinyl liner was first
the 1960s as a solution to taste and odor
ints from customers. TCE was used as a
, allowing the vinyl polymer resin to be
nd applied through a spraying process onto
es. Two possible solutions to the leaching
were studied: removal of the vinyl liner
ining of the pipes with cement mortar; or
he pipes with cement mortar over the vinyl
he cement mortar lining of the vinyl lined
-cement pipe considerably reduced the
oncentrations when compared to pipes in
treated condition. The percent reduction
d to be consistent under both static and
c conditions. To date, cement mortar lin-
ve been applied to an existing water distri-
system within a local community containing
ar feet of VL/AC pipe installed in 1979.
treatment the concentration of TCE in the
assing through these pipes was 145 ppb.
yl liner was removed with a series of wire
, the line was flushed with water and the
lining applied. TCE concentrations of 7
re found after the process, amounting to a
n of about 95%. (Baker-IVI)
155

IBUTED COMPUTER CONTROL OF
R TREATMENT PROCESSES,
and Eddy, Inc., Boston, MA.
zzimenti.
of New England Water Works Associ-
ol. 97, No. 2, p 150-157, June, 1983.

tors: *Quality control, *Drinking water,
treatment facilities, Computers, Micro-
ors, Management, Filters, Pumps.

ous control systems are required in modern
reatment plants in order to ensure the prep-
of high quality drinking water in an effi-
anner. Controls must manage filter flow-
ilter backwashing, chemical feed systems,
tation operation, filtered water distribution,
e handling of wastewater and sludge. In
to monitoring and controlling process var-
ontinuously, analog control, digital or dis-
ous control is also important and includes
ms as opening and closing of valves, start-
stopping of pumps, or the operation of a
equence. The most common types of instru-
on used in process control of water treat-
lants are pneumatic and electronic. The
development of the microprocessor has al-
instrumentation and process control equip-
o become smaller and more reliable for
control operations. The overall structure
gital, microprocessor-based distributed con-
stem for a water treatment plant is de-
. A distributed control system has many
ages, particularly for the larger facilities.
ity is greatly improved over conventional
entation, due to the reduction of electrome-
l devices such as relays or indicator and
r mechanisms, which have a higher rate of
A system such as this affords the owner
flexibility for future expansion of a plant,
tle increase in instrumentation hardware, as
for modifications to a system resulting from
nce derived in operating the process. The
also allows for easily correcting those prob-
hich might arise during plant startup. Cost
are also significant in terms of decreased installation and wiring costs and in the reduction of panel type instrumentation and lower maintenance for the equipment that is needed. (Baker-IVI)
W84-01160

WATER QUALITY FROM WATER-HARVESTING SYSTEMS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
G. W. Frasier.
Journal of Environmental Quality, Vol. 12, No. 2, p 225-231, April-June, 1983. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Water harvesting, *Drinking water, *Water quality, Arizona, Heavy metals, Arsenic, Precipitation, Runoff, Dusts.

Water harvesting is a technique used to supply animal and domestic drinking water in areas where more conventional methods cannot supply sufficient water. The water collected by a water-harvesting system has the potential of being contaminated by deterioration by-products of the materials used in constructing the system, from dust that is deposited on the catchment surface, or from impurities trapped in the rain. During a 3-y period, runoff water samples were collected for water quality analyses from 10 types of catchment treatments on operational and experimental water-harvesting systems in Arizona. Atomic absorption spectrophotometry techniques were used to determine the concentrations of Al, As, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Hg, K, Na, V, and Zn in each water sample. There was no evidence that deterioration of the catchment treatments would cause a contamination of the runoff water. With the exception of As, most samples had significantly lower concentrations of these constituents than the maximum standards for animal or domestic drinking water supplies. Arsenic was the only chemical consistently found in the water samples at potentially hazardous concentrations for domestic drinking water supplies. Excessive As concentrations were not associated with any specific type of catchment treatment. The logarithm of As concentration in the runoff was positively correlated with the logarithm of the time since the previous rain, and negatively correlated with the logarithm of the total rainfall quantity. Apparently, As was deposited on the catchment surface as dryfall dust, and/or was washed from the atmosphere by the rainfall. (Author's abstract)
W84-01196

EVALUATION OF CARTRIDGE FILTERS FOR THE REMOVAL OF GIARDIA LAMBLIA CYST MODELS FROM DRINKING WATER SYSTEMS,
Sequoia and Kings Canyon National Parks, Three Rivers, CA.
W. R. Long.
Journal of Environmental Health, Vol. 45, No. 5, p 220-225, March/April, 1983. 7 Fig, 7 Tab, 6 Ref.

Descriptors: *Cartridge filters, *Drinking water, *Giardia cysts, Protozoa, Water treatment, Filtration, Particle size, Turbidity, Sand filters.

Numerous waterborne outbreaks of Giardiasis have occurred in recent years in many areas of the United States. Since Giardia lamblia cysts are resistant to chlorination, removing cysts by filtration would be a solution to water treatment. Cartridge filters were analyzed for filter efficiency by the use of turbidity measurements, particle size analysis and scanning electron microscopy analysis. The cartridge filters were challenged by a solution of microspheres (5.7 micrometers in diameter, which is smaller than a Giardia lamblia cyst) at a concentration of 40,000 to 65,000 spheres per ml. Calculations were then performed for turbidity reduction, particle number reduction and visual counts of microspheres. Ten of 17 cartridge filters removed over 99.99% of the microspheres. These would also be effective in removing Giardia lamblia cysts. In several cases, actual performance differed from the manufacturer's micrometer retention rating of the filter. Sand media were not effective in removing the microspheres. (Author's abstract)
W84-01203

ROUTINE COLIFORM MONITORING AND WATERBORNE DISEASE OUTBREAKS,
Columbia Univ., New York. School of Medicine.
O. Batik, G. F. Craun, and W. O. Pipes.
Journal of Environmental Health, Vol. 45, No. 5, p 227-230, March-April, 1983. 3 Tab, 6 Ref.

Descriptors: *Coliforms, *Drinking water, *Waterborne disease, Bacteria, Water quality standards, Water quality, Human diseases.

A comparison of coliform monitoring results was made between water systems experiencing a waterborne outbreak and systems in which an outbreak had not been reported. In a study of community systems, the outbreak and comparison communities were not found to differ in regard to positive coliform results within the three months prior to the outbreak. Also, no statistical difference was observed between outbreak and comparison communities with respect to the number of times the coliform standard was exceeded per number of samples collected and mean number of coliform organisms in the water system during an entire three year period. A study of coliform monitoring results for non-community systems in Pennsylvania show no difference in positive coliform results between non-community systems experiencing an outbreak and those not experiencing one. These data provide no evidence that coliform monitoring provides any prediction of outbreaks of waterborne disease in non-community systems. These results must be interpreted cautiously for several reasons, including small sample size and incomplete reporting of waterborne outbreaks. It is suggested that regulatory agencies should carefully examine the relative importance of the routine coliform monitoring of tap water in the surveillance of waterborne disease. (McKeon-IVI)
W84-01204

USE OF A PILOT PLANT TO IMPROVE WATER TREATMENT CONDITIONS,
W. B. Thomas.
Power Engineering, Vol. 87, No. 9, p 54-55, September, 1983. 1 Fig.

Descriptors: *Pilot plants, *Water treatment facilities, Cooling towers, Demineralization, Desalination.

Use of a small pilot plant, designed to duplicate as nearly as possible the conditions in the full scale equipment, can yield valuable operating data and suggest improvements in the design of the full sized facility. A pilot plant for a demineralization system should duplicate the full sized equipment except for instrumentation. Flow rates during demineralization, rinse, chemical injection and backwash should be the same, but flow distribution, bed pressure drop, and proper backwash bed expansion should not be duplicated. Once the pilot plant is operable the first exercise should be operator training as experience gained will enable operators to more quickly spot malfunctions. After the full sized facility is operating, pilot plants can still be used to study possible improvements in the system, to evaluate the use of new cleaners and other chemicals. With the growing emphasis on plant effluent reduction, pilot sized equipment is becoming increasingly useful in evaluating cooling system operation. The effect of higher water concentrations can be studied without the danger of increased fouling, heavy scaling, or corrosion. (Baker-IVI)
W84-01234

MANAGING A WATER UTILITY,
Richardson Dept. of Public Services, TX.
M. L. Haney.
Southwest and Texas Water Works Journal, Vol. 64, No. 12, p 4-6, 20 and 22, March, 1983.

Descriptors: *Public utilities, *Professional personnel, *Metropolitan water management, Texas, Water quality management.

The major duty and responsibility of any utility manager is to provide good, safe, and potable water to his customers in the quantity required. He must then safely remove the amount of water that

becomes waste and see that this waste does not become a health hazard. The major cost of operating a utility is personnel, and the training, management, and dedication of this personnel is most important. Professional obsolescence is a major hazard as more automation of services and computerization of requirements demands top efficiency from skilled workers. (Wheatley-IVI)
W84-01314

PRIVATIZATION OF WASTEWATER TREATMENT,
Young (Arthur) and Co., New York.
H. J. Goldman, and R. D. Vought.
Southwest and Texas Water Works Journal, Vol. 65, No. 3, p 5-6, June, 1983.

Descriptors: *Wastewater treatment, *Economic aspects, *Private ownership, Community development, Cost allocation.

The private sector has an excellent track record in building and operating wastewater treatment plants to serve its own needs. The economics of owning and/or operating treatment facilities are attractive to the private sector. Privatization is cost effective for the communities as well. It can even compare favorably to a federal grant in terms of user fees. There are several ways in which privatization can be implemented: development of industrial on-site treatment facilities with expansion potential for community growth requirements, sale of community treatment facilities to a local industry, or construction by a private group to service both community needs and industrial requirements. The need for state participation in fostering privatization is evident. Privatization of wastewater treatment is a viable alternative to the financing crisis facing many communities. Privatization is just at the starting line. The private sector is interested, the environmental regulatory agencies are supportive, and the public needs it. (Wheatley-IVI)
W84-01315

GOING DEEP CUTS SEWER, LIFT STATION COSTS,
Winzler and Kelly, Eureka, CA.
M. Kincaid.
Water Engineering and Management, Vol. 130, No. 4, p 26-27, April, 1983. 2 Fig.

Descriptors: *Wastewater facilities, *Pipelines, *Pumps, *Groundwater, Soil water table, California, Costs.

In addition to challenging geotechnical and hydrologic problems encountered during the construction of a pair of Crescent City, California wastewater collection systems, the contractors also had to deal with some touchy archaeological situations. An increase in the number of hepatitis cases in this urban area indicated the need for the updating of the wastewater treatment system. High groundwater was a common problem in the planned construction of the new pipelines. The cost for multiple lift stations required by an above groundwater pipeline system made the cost of a deeper system with fewer lift stations more cost effective. In the construction phase, several burial sites were encountered requiring rerouting of some of the pipelines. Early in 1981, the last segment of the project was completed and placed in operation. (Wheatley-IVI)
W84-01316

SOFTWARE SOLVES WATER SUPPLY PROBLEMS,
H. Rogers.
Water Engineering and Management, Vol. 130, No. 4, p 38-39, April, 1983.

Descriptors: *Computers, *Water supply systems, Management planning, Water supply, Water demand, Water distribution, Costa Rica.

Hydraulics and water resource studies are areas of rapid advancement in computer software technology. It is now possible to take a complete water supply system and analyze it as it stands without alteration or simplification. This new technology was used in a Costa Rica project called the San Jose Water Supply - Stage 2 of the Distribution System - Second Computer Model. The objective was the creation of a computer model in San Jose to serve as a design tool for Costa Rican engineers, enabling them to study the performance of the system and to design extensions as the city expands. The version of the software tailored for use on this computer can analyze a network containing up to 200 nodes and 250 connectors. This computer system has also been used in projects involving communities of populations ranging from 250,000 to 1,250,000. Other water related software programs include AQUIFER, which simulates groundwater levels in an aquifer under complex conditions, SLIPSERF, which is an interactive program for the rapid and economic location of the critical slip circles of non-homogeneous slopes under varying conditions, and LMGEN, which comprises three programs for sewer design. (Baker-IVI)
W84-01321

CLEAR WATER FOR CAYUGA,
MacNeill (John S.) Jr., Homer, NY.
A. W. MacNeill, and J. M. Scanlon.
Water Engineering and Management, Vol. 30, No. 5, p 41-42, May, 1983. 3 Fig.

Descriptors: *Turbidity, *Water treatment facilities, *Water quality control, Drinking water, Lakes, Lake Cayuga, New York, Filtration, Clarification, Clarifiers.

Cayuga Lake provides the potable water supply for an upper New York State village with a population of about 600 and an adjacent town with 92 residential connections. The existing water treatment plant, built in 1935, provides an average of 125,000 gpd of water. The system consists of an intake structure 300 ft offshore and a low pump head to transfer water through an aerator. Water flows from the aerator by gravity through a settling tank and on to a rapid sand filter. Once the filtered water is chlorinated it is discharged to a wet well below grade. Water is delivered through high pressure injection pumps at a rate of 150 gpm. Turbidity levels in the raw water of the lake vary from 1-100 NTU. The high turbidity breakthrough that occurs in the water system is largely due to storm water run-off and wave action in the lake. To combat this problem water is pumped through a cyclone separator. Downstream from the separator, alum is injected into the water at a rate of 10 mg/l to neutralize the electric charge of the suspended particles and form a precipitate. A depth clarifier acts as a contact flocculator. Effluent from the depth clarifiers is fed to a depth filter. A granular carbon system for polishing the water brings the quality within prescribed guidelines. The innovative design includes a top layer of petroleum base carbon with a fine garnet bed to prevent dusting or loss of minute carbon particles in the finished water. Post chlorination is the final step. (Baker-IVI)
W84-01322

COMPUTERISED CONTROL AND MONITORING OF A SWEDISH WATER TREATMENT PLANT,
Skaraborgs Vattenverksforbund (Sweden). Process Industries Division.
B. Karlsson, and B. Kindblom.
Water Services, Vol. 87, No. 1045, p 112-116, March, 1983. 5 Fig.

Descriptors: *Computers, *Water treatment facilities, Automation, Water quality control, Sweden.

The Borgunda Water Treatment Plant in Sweden has a daily capacity of 40,000 cu m of water and meets the needs of 75,000 people. A computerized control and monitoring system was commissioned in 1981 which has raised the efficiency of the production and distribution of pure water and cut down the manning of the plant. There are about 90 km of pipelines, some sections of which are 10, 20, and 30 km long. Raw water intake extends 970 m out into Lake Vattern, at a depth of 16 m. The primary objective of control is to maintain as uniform a flow as possible by leveling out variations in the water consumption with the aid of the reservoirs. The Hjallo intake station has three water pumps with capacities of 750, 1350, and cu m/hr. It is possible to adapt the water f the varying demand in the municipalities w aid of these pumps. Chlorine and ammo added to the water before it is pumped t gunda via a reservoir and a booster stati Borgunda the water is treated in six rapid after which chlorine, ammonia, and lime are to the water. The Borgunda plant has 10 units. Pure water is pumped via reservoirs pumping station to elevated reservoirs. The puter center is located at Borgunda from whi water treatment plant and distribution netwo controlled and monitored. The central proc unit in the SINDAC system is of type DS 10 a capacity of 64K words and a 16-bit core m as well as a moving head disc mass me comprising three discs with a total memory c ity of 3.9 million words. The SINDAC sys very reliable and it monitors its own functi (Baker-IVI)
W84-01333

A UNIQUE OPPORTUNITY TO UPGR WATER/WASTEWATER SYSTEMS,
Camp, Dresser and McKee, Inc., New York.
For primary bibliographic entry see Field
W84-01336

5G. Water Quality Control

GROUND WATER CONTAMINATION IN UNITED STATES,
Academy of Natural Sciences of Philadelphia,
V. I. Pye, and R. Patrick.
Science, Vol. 221, No. 4612, p 713-718, Au 1983. 1 Fig, 1 Tab, 38 Ref.

Descriptors: *Groundwater managem *Groundwater pollution, Water pollution con United States, Drinking water, Quality con Legislation, Standards, *Water quality stand

Since about 50% of the drinking water suppl the United States comes from groundw sources, contamination of this supply is of incr ing concern. The hazards posed by contamin vary according to the volume discharged, the icity of the compounds, their concentration in aquifer, their persistence in the environment, the degree of exposure to them. As such cont nation occurs underground and out of sight, very difficult to observe until the effects are s in the damage caused, which is often irreversi The precise source of the contamination may undeterminable by that point. Sources of grou water contamination include point sources such waste dumps, accidental spills, and waste treatm site deposits, along with many nonpoint sour such as agricultural or mining operations. present there is no federal program dealing spec cally with the problem of groundwater contami tion. The framework of federal laws that can used is a group of statutes which are aimed prim ily at other environmental problems but whi touch indirectly on ground water problems. T EPA did propose a national groundwater strate in 1980 which included the development of st management and protection strategies, the dev opment of a groundwater classification system, a EPA coordination of existing federal programs f groundwater protection. The technical approa includes the use of siting and design criteria, be management practice, effluent standards, innov tive and alternative technologies to achieve pe formance standards and numerical groundwat quality standards and economic incentives. (Bake IVI)
W84-01087

MICROBIAL TREATMENT OF SOIL T REMOVE PENTACHLOROPHENOL,
Cornell Univ., Ithaca, NY. School of Chemic Engineering.
R. U. Edgehill, and R. K. Finn.
Applied and Environmental Microbiology, Vo 45, No. 3, p 1122-1125, March, 1983. 2 Fig, 1 Tab 17 Ref.

ors: *Pentachlorophenol, *Pesticides, ntamination, *Arthrobacter, *Water pollu- ention, Bacteria, Cleanup operations, Phe- ticides.

noculation of bacteria capable of degrad- achlorophenol (PCP) into PCP-contami- l was investigated as a prophylactic meas- educe the hazards of runoffs when spills when wooden poles freshly treated with taining preservatives are located near nd lakes. In laboratory tests at 30 C, the dition of 1,000,000 PCP-utilizing Arthro- lls per g of dry soil reduced the half-life sticide from 2 wk to <1 day. Soil inocula- was shown to be an effective way to the PCP disappearance rate in a test con- n an outdoor shed. (Author's abstract) 91

EGIONAL EFFECTS OF THE EF- 'S FROM THE MISHRAQ SULPHUR IN IRAQ ON THE HYDROLOGICAL

niv. (Iraq).
ary bibliographic entry see Field 5B.
05

WATER QUALITY CHARACTERIS- DETENTION BASINS,
n Univ., NJ. Dept. of Civil Engineering.
rrara, and P. Witkowski.
of Environmental Engineering, Vol. 109, 428-447, April, 1983. 10 Fig, 7 Tab, 14

ors: *Storm water, *Detention reservoirs, ollution control, Particle size, Chemical lemand, Phosphorus, Nitrogen, Effluents, ation.

of stormwater detention basins for the pose of flood control and mitigation of runoff loads has been promoted. Howev- limited data and methods of analysis and n of pollutant removal in detention basins is paper presents the results of a storm- ality sampling program conducted to de- e particle size distribution and the time influent and effluent concentrations of oxygen demand (COD), total phospho- l kjeldahl nitrogen (TKN), and solids arious storm events. Concentrations in arate particle size ranges for each of the ameters was determined. The basin is be generally effective in reducing solids, d total phosphorus. TKN concentrations ings were generally increased. The effec- of the detention basin in reducing pollut- s appears to be related to two factors, equalization and sedimentation. Dry water quality in the detention basin deter- e importance of the former, whereas the size distribution for each pollutant deter- e degree of sedimentation. (Author's ab-

08

ED MATERIAL SEDIMENTATION DESIGN,
ngineer Waterways Experiment Station, g, MS.
ntgomery, E. L. Thackston, and F. L.

of Environmental Engineering, Vol. 109, 466-484, April, 1983. 12 Fig, 2 Tab, 8 Ref.

ors: *Sedimentation basins, *Dredged ma- Design criteria, Sedimentation, Storage ca- uspended solids, Effluents, Slurries.

res have been developed for designing material sedimentation basins. These pro- can also be used for designing sedimenta- ns for other slurries having high suspended ncentrations. Dredged material sedimenta- ns are slightly different from those used in nd wastewater treatment in that the material basins must provide for sedimen- achieve acceptable effluent quality while providing storage volume for several years of material dredged from local waterways. Guidance is presented for field sampling and laboratory testing required to obtain data for sediment characterization, data analysis, sedimentation basin (containment area) design, and estimating storage capacity required. Settling tests performed in a 8-in. (20 cm) diameter column were found to be satisfactory for defining dredged material settling behavior. Settling behavior in the freshwater environment was best described by a flocculent settling test, while behavior in a salt-water environment was best described by a zone settling test. Procedures are presented for designing new containment areas for suspended solids retention and for evaluating the suspended solids retention potential of existing containment areas during planned disposal activities. The field verification work performed during this research indicated that conservative values could be estimated from laboratory tests for solids concentrations expected in the dredged material sedimentation basins. (Author's abstract)
W84-01109

FEATURES OF FEDERAL LAW THAT ENCOURAGE ADOPTION OF LAND APPLICATION OF WASTEWATER,
Wisconsin Univ.-Madison. Law School.
D. T. Massey.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 121-133, April, 1983. 36 Ref.

Descriptors: *Land disposal, *Wastewater disposal, *Sludge disposal, *Legal aspects, Federal jurisdiction, Regulations, Public policy, Water pollution control, Effluents, Standards.

Federal statutes and regulations and Environmental Protection Agency (EPA) guidelines and policies tend to aid and encourage land application of municipal wastewater effluents and sludges and make the method of treatment increasingly attractive. Land application systems are made more attractive by federal law relating to eliminating the discharge of pollutants into navigable waters, stringent standards on discharges from treatment works, and restrictions imposed on permits for discharging effluents and sludges into navigable waters and the ocean. Provisions of federal law tending to aid and encourage land application systems relate to cost-share grants for construction of treatment works, level of effluent and sludge treatment prior to application on land, pretreatment requirements for pollutants introduced into treatment works, federal grants awarded for research and demonstration projects, and requirements for developing public information and education programs. (Author's abstract)
W84-01143

MINNESOTA'S HAZARDOUS WASTE SITING CRITERIA,
Minnesota Waste Management Board, Crystal.
A. P. Shilepsky, and R. B. Pulford.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 165-173, April, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Waste disposal, *Environmental protection, *Site selection, Legislation, *Minnesota, Management, Groundwater management, Hazardous materials.

Minnesota currently has no commercial hazardous waste disposal facility. Therefore the 1980 Minnesota Legislature created the Waste Management Board, responsible for siting at least one land disposal facility and having the authority to condemn land and supersede local zoning. Minnesota rules prohibit facility location within 1,000 ft of a protected lake, pond, or flowage, or within 300 ft of a protected stream. Siting is also prohibited in natural marshes 10 acres and larger which are eligible for classification as US deep, or open fresh water marshes. Due to the hydrogeologic unpredictability in a topography characterized by sinkholes, caves and underground drainage, attempts were made to remove karst development areas from consideration. Analyses must be performed to determine if leachate, run-off, or other natural processes occurring during facility development will affect nearby protected waters or wetlands. Since both rivers and lakes may be surface sources of drinking water in the state, concern was expressed by some citizens that any downstream water intake, regardless of distance, should eliminate a site from further consideration. The Waste Management Board did not share this view. In order to protect groundwater from contamination, consideration was given to sites which were clay-rich quarternary deposits where regional data indicated sustained well yields of one gallon per minute or less; devoid of major buried quarternary aquifers; composed of Precambrian igneous and metamorphic bedrocks as these are nonaquifers; and possessing a 50 ft or more depth to bedrock. When the site selection was narrowed down to only 20 possibilities, a drilling program was used to further define the groundwater situation, with the presence of an aquiclude becoming a requirement. Specific monitoring methods are to be part of the engineering design examined in the Environmental Impact Statement. (Baker-IVI)
W84-01146

GROUND-WATER MOUNDING DUE TO ON-SITE SEWAGE DISPOSAL,
Santa Clara Univ., CA. Dept. of Civil Engineering.
E. J. Finnemore, and N. N. Hantzche.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 2, p 199-210, June, 1983. 7 Fig, 1 Tab, 16 Ref. EPA grant P009211010.

Descriptors: *Groundwater mounding, *Wastewater disposal, *Soil disposal fields, Mathematical studies, Wastewater management, Sites, Geohydrology.

Localized ground-water mounding beneath larger on-site sewage disposal fields (leach fields) may be a major problem which previously had not been adequately addressed. Existing methods to predict mounding, mainly developed for ground- water recharge spreading basins, are reviewed for applicability to sewage disposal fields. A most appropriate and accurate method is selected and considerably simplified to provide a convenient, straightforward prediction procedure for regulatory agencies and designers. The major simplification, to a single equation, is particularly accurate after longer wastewater application times, of say 10 to 20 years, when mounding is of most concern. Sensitivities of the procedure to the various simplifications, site factors, and design and management options are discussed and presented in graphical form where significant. Alternative means to reduce mounding are reviewed. Mounding problems and potential mitigation measures should be made more widely known, and long-term field verification of the theory is needed. (Author's abstract)
W84-01154

HOW MASSACHUSETTS PLANS TO MEET THE WATER SUPPLY CHALLENGE OF THE 1980'S,
Massachusetts Div. of Water Supply, Boston.
I. Bhatti.
Journal of the New England Water Works Association, Vol. 97, No. 2, p 114-118, June, 1983. 4 Ref.

Descriptors: *Water supply development, *Water quality control, *Massachusetts, Resources management, Water management, Water shortage, Groundwater management, Water conservation.

New demands for purity and adequacy of supply are being placed on water managers who operate water supply systems and on water regulatory agencies which are responsible for regulating the quality and quantity of drinking water. More than 95% of the population of Massachusetts is served by some form of public water system and the remaining population gets drinking water from individual on-lot wells. More than half the communities are dependent on groundwater sources. A total of 758 municipal water supply wells were recently tested for quality control, with one-third showing detectable amounts of volatile organics and three exceeding the acceptable levels. Water quantity problems also exist in the state, with a rash of

communities experiencing water shortages in 1980 and 1981. Statewide demand has increased from 91 GPCD in 1950 to about 150 GPCD in 1980 and will, at this rate, reach a deficit of 70-140 MGD for eastern Massachusetts by 1990. In an attempt to improve this situation, Chapter 286 of the Acts of 1982 was passed in July of 1982 providing $107.5 million for water supply purposes with $60 million set aside for a Leak Detection and Rehabilitation Program, $25 million for construction of water filtration plants, $10 million for water supply contamination clean-up and to provide a temporary water supply, $2.5 million for water conservation devices in public buildings; and $10 million for the acquisition of land to protect future groundwater sources. (Baker-IVI)
W84-01157

WATER UTILITY COMPLIANCE WITH HAZARDOUS MATERIALS, SUBSTANCES AND WASTE REGULATIONS,
Connecticut Water Co., Clinton.
T. R. Marston.
Journal of New England Water Works Association, Vol. 97, No. 2, p 134-137, June, 1983.

Descriptors: *Regulations, *Hazardous materials, *Utilities, Sludge, Water treatment facilities, Wastewater.

One area of concern is the transporting of treatment chemicals from a central location to outlying treatment stations by water department trucks. The most difficult aspect of complying with the regulations for transporting hazardous materials often concerns shipping papers. If an amount of a hazardous substance equal to or greater than its reportable quantity is to be transported, it must be so noted on the shipping papers. Concerning waste generated by the water industry, the largest quantity is sludge which is not classified as a hazardous waste by the EPA. However, there is concern over the possible toxicity of this material. Additional hazardous wastes can be generated at water utilities if a company cleans water meters in an acid or caustic solution or if spills in the chemical feed system are retained in a vault or waste tank. If a company generates less than 1000 kg (454 lb) of waste in a calendar month, it is classified as a small quantity generator and does not have to meet the registration, personnel training, contingency planning and emergency requirements of a larger generator of hazardous waste. A small quantity generator must still handle and dispose of the waste in such a way as to meet all regulatory requirements, including packaging, marking and labeling waste to meet all Department of Transportation regulations as well as additional EPA marking requirements for hazardous waste, and offering the waste to a licensed transporter for disposal at a licensed treatment, storage and disposal facility. (Baker-IVI)
W84-01159

MANAGING RUNOFF FROM A SMALL, PAVED BEEF FEEDLOT,
Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
W. M. Edwards, L. B. Owens, and R. K. White.
Journal of Environmental Quality, Vol. 12, No. 2, p 281-286, April-June, 1983. 8 Fig, 2 Tab, 14 Ref.

Descriptors: *Feedlot runoff, *Water pollution control, Wastewater management, Storm runoff, Settling basins, Filter strips, Nutrients, Biological oxygen demand, Chemical oxygen demand, Settleable solids, Infiltration.

Each year for 3 yr, 56 steer calves were fed to market weight on a corn-silage and shelled-corn ration in a 243-sq m paved lot. Storm runoff was measured and sampled as it left the feedlot, and again after it passed through a shallow, concrete settling basin and two consecutive 30 m long by 4.5 m wide sod filter strips. Storm runoff amounts and transport of TS (total solids), COD (chemical oxygen demand), BOD5 (5-d biological oxygen demand), N (total nitrogen), and P (total phosphorus) were smaller during the fall and winter months, when the steers were small and being fed silage than during May through July, when the animals were larger and eating shelled corn. The settling basin reduced transport of TS and COD by about 55%, while retaining only 35-40% of the BOD5, N, and P. Total reduction of all parameters was increased to 80-90% in the filter strips. The basin was more effective in large storm events, and the filter strips were more effective when the basin was slowly drained after settling of the settleable solids. Rainfall on the filter strips reduced the concentration of all parameters during large storms, and infiltration during other events reduced transport to downstream areas. (Author's abstract)
W84-01189

EFFECTS OF POPULATION AND INDUSTRIAL CHANGE ON ENVIRONMENTAL QUALITY IN MAJOR CONURBATIONS,
Victoria Univ. of Manchester (England). Dept. of Economics.
N. Lee, and C. Wood.
Journal of Environmental Management, Vol. 16, No. 2, p 91-107, March, 1983. 3 Fig, 5 Tab, 30 Ref.

Descriptors: *Urban areas, *Environmental quality, Industrial wastes, Domestic wastes, Human populations, Population dynamics, Urban planning, Forecasting, Environmental control.

The environmental quality which can be achieved in a conurbation depends as much upon its domestic and industrial activities as on the environmental protection measures which are enforced. An analytical framework is developed to identify the main relationships between these variables. The framework is used, first, to examine the relationship between population and industrial change and environmental quality in Greater Manchester (England) for the years 1966-76, using published or otherwise accessible data. Large changes are shown to have taken place in the level, composition and spatial distribution of waste generating activities over this period. Data describing these changes are used in conjunction with information relating to waste coefficients and emission factors to explain the main changes in environmental quality that occurred in the conurbation over the period. The analytical framework is then used, in conjunction with economic and population forecasts, to determine likely future changes in population and industrial structure by the mid-1980s and their probable consequences for waste and pollution levels in the conurbation. These preliminary analyses form the basis for the further development of this type of forecasting study, preferably in cooperation with existing planning and environmental control authorities. A two-stage approach to environmental forecasting appears to be the most promising way to proceed. The first stage would produce strategic forecasts for large zones using more readily accessible data and thereby identify environmentally significant areas or activities for further study. The second stage would consist of more detailed studies, involving the collection and analysis of additional survey or cast study material for the areas or activities so identified. (Author's abstract)
W84-01207

SOIL MANAGEMENT AS IT AFFECTS NUTRIENT LOSSES FROM A TROPICAL SOIL IN NIGERIA,
Ibadan Univ. (Nigeria). Faculty of Technology.
G. E. Osuji, and O. Babalola.
Journal of Environmental Management, Vol. 16, No. 2, p 109-116, March, 1983. 6 Tab, 19 Ref.

Descriptors: *Soil management, *Tillage practices, Nutrients, Agricultural runoff, Leaching, Nitrogen, Soil erosion, Water pollution sources, Storm seepage, Fertilizers.

Five tillage treatments, namely bare fallow, no-tillage, local or manual tillage, plowing only, and conventional tillage (plowing and harrowing), were established on runoff plots on an alfisol with a 5% slope in southern Nigeria. The objective was to determine the effects of these tillage practices on nutrient losses in runoff and soil erosion from shallow soils derived from basement complex rocks. Nutrient losses in both runoff and eroded sediments were in the order: bare fallow > pl > conventional > manual > no-tillage. I cases, nitrogen suffered the greatest loss. Nu losses in runoff water were not very high, but relative concentrations in runoff could pose p tial environmental pollution hazards. Lea losses of nitrogen, as shown by higher conce tions of NO3-N in the subsurface or inter- water, were higher than losses in runoff water this may account for the relatively low effici of applied nitrogen fertilizers in tropical soils. no-tillage technique was found to be an effe means of checking loss of nutrients from agr tural land in the tropics. (Author's abstract)
W84-01209

THE DEPENDENCE OF SHORELINE C TAMINANT LEVELS UPON THE SITING AN EFFLUENT OUTFALL,
Cambridge Univ. (England). Dept. of App Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 130, p 153- 1983. 5 Fig, 7 Ref.

Descriptors: *Outfall, *Environmental effe *Advection, *Diffusion, Water pollution con Path of pollutants, Mathematical models, Efflue Shores.

It is shown that the advection-diffusion equa for contaminant dispersion in water of vari depth admits of an inverse approach in which stochastic mean concentration at a fixed sensi location is calculated for arbitrary discharge si A ray method is used to obtain simple approxim solutions for the inverse problem when the se tive location is situated at the shoreline. This m explicit the considerable improvements in shore pollution levels which can be gained by sit effluent outfalls further away from the shore. (A thor's abstract)
W84-01238

ACTIVE VERSUS PASSIVE WATER QUALI MONITORING PROGRAMS F WASTEWATER DISCHARGES,
Texas Tech Univ., Lubbock. Dept. of Civil En neering.
G. F. Lee, and R. A. Jones.
Journal of the Water Pollution Control Federati Vol. 55, No. 4, p 405-407, April, 1983. 6 R

Descriptors: *Water quality control, *Water m agement, Data acquisition, Monitoring, Water p lution control, Wastewater treatment, Wastewa facilities, Sampling, Hazard assessment.

The first step that should be considered in develo ing cost-effective technically valid, active wa quality monitoring programs is to determine whi aspects of water quality are of concern to a parti ular location, i.e., to what uses the water und study is to be put. A hazard assessment approa should guide both the development of a monito ing program and the interpretation of the result Such an approach allows the physical, chemic and biological characteristics of the water to b considered in light of their potential impact o beneficial uses of the water by man. The wat quality monitoring program should incorpora sampling sites and frequencies and parameters fo measurement that have sound technical justifica tion. It should be flexible enough so that it can b adjusted on the basis of analytical findings, an there should be a short turn-around time betwee sample collection and data review by those respon sible for water quality control at the site. Rigid fixed-station, fixed-period sampling should be re duced and supplemented with special purpose sam pling where needed. Part of the funds availabl should be devoted to toxicity testing as chemica analyses generally do not provide reliable indica tions of water quality impairment. (Baker-IVI)
W84-01241

MONITORING FOR WATER QUALITY FIXED STATIONS VERSUS INTENSIVE SUR VEYS,
Washington Univ., Seattle. Dept. of Biostatistics.
G. van Belle, and J. P. Hughes.

the Water Pollution Control Federation, Vo. 4, p 400-404, April, 1983. 1 Tab, 11

s: *Monitoring, *Water quality control, , Water sampling, Networks, Water pol- rol, Surveys.

limits and definitions of water quality led, along with effective methods of and these tasks were given to the EPA pment. The three major responsibilities dminister funds for the construction of waste treatment plants, set effluent limi- define the technological standards that sed to achieve these limits, and to col- ith the states in monitoring water quality ing annual reports on the nation's water network of water quality monitoring s since been developed across the coun- ve as a natural starting point for the a fixed station network. In the contro- ntensive surveys vs fixed stations, the sts that intensive surveys do not provide st effective evaluation of long-term in ity. Rather, they are effective for study- erm fluctuations in other hydrological a, and cause-effect relationships of pollu- work of stations selected probabilistical- vide valid estimates of water quality and ater quality. The price of this generali- increased variability of the estimates. derived from an intensive survey of a will be less variable, but will not be le. Estimates derived from networks se- non-probabilistic means may produce nates of absolute water quality, but can estimates of trends with less variability. mpling of a well defined, fixed number ters can significantly reduce sampling formity and quality of data collected e improved in both the field and lab. work monitoring programs can provide onal and national information about ater quality. (Baker-IVI)

E QUALITY AT DEEP COAL MINE

ia State Univ., University Park. Inst. ch on Land and Water Resources. ies, and A. J. McDonnell. ources Bulletin, Vol. 19, No. 2, p. 235- 1983. 3 Fig, 3 Tab, 16 Ref.

s: *Coal mine, *Mine drainage, *Acid age, Trace metals, Overburden, Water erburden, Calcareous materials.

ere collected from the drainages of inac- coal mine sites located in eight states. quality was found to be highly variable, ority of sites exceeding federal effluent delines. Concentrations of trace metals admium, mercury, zinc, and nickel were resence of overburden calcareous mate- own to affect drainage quality. A con- ern of pH-acidity response was found to he mine sites monitored. An empirical as developed to characterize this re- uthor's abstract)

OF LAND USE AND TOPOGRAPHY E WATER QUALITY VARIABLES IN D EAST TEXAS,
Austin State Univ., Nacogdoches, TX. Forestry.
J. D. McCullough, and A. B. Granillo. ources Bulletin, Vol. 19, No. 2, p 191- 1983. 1 Fig, 3 Tab, 27 Ref.

s: *Land use, *Topography, *Forest , Small watersheds, Suspended sedi- ter quality, Drainage density, Nitrogen, s, chloride, Texas.

riation of five water quality variables zed using composite water samples col- iodically from eight small watersheds sq km) in forested East Texas during 1977 through 1980. Based on 31 observations during the four-year period the average yield of nitrate-nitrite nitrogen (NNN), total kjeldahl nitrogen (TKN), total phosphorus (PO4), chloride (CHL), and total suspended sediment (TSS) were 1.43, 21.96, 3.09, 50.11, and 90.39 ka/ha/yr, respectively. Compared to the water quality standards of the U.S. Environmental Protection Agency (1976) and the Texas Department of Water Resources (1976) for CHL, TSS and NNN, none of the observations exceeded the limits for public water supplies. The study showed that forested watersheds normally yielded stream flow with better quality than that from agricultural watersheds. Watersheds of greater percent of pasture area, mean slope, stream segment frequency, and drainage density produced greater concentrations for these five chemical parameters in water samples. Meaningful equations were developed for estimating mean average yields for each chemical parameter for each watershed with R(2) ranging from 0.77 to 0.96 and standard error of estimates from 17 to 33 of the observed means. (Author's abstract)
W84-01288

THERE IS AN ANSWER TO GROUNDWATER CONTAMINATION,
Calgon Corp., Pittsburgh, PA.
R. P. O'Brien, and J. L. Fisher.
Water Engineering and Management, Vol. 130, No. 5, p 30-36 and 70, May, 1983. 6 Fig, 4 Tab.

Descriptors: *Activated carbon, *Water quality control, *Groundwater pollution, Water treatment, Drinking water, Organic compounds.

Granular activated carbon (GAC) is being increasingly used to treat and purify contaminated groundwater. Results from 31 different operating plants that employ GAC to remove toxic organic compounds from groundwater supplies are detailed. Sources of contamination of the groundwater included leachate from lagoons and dumpsites, industrial accidents and spills, and spills resulting from railroad or truck accidents. Industrial accidents accounted for 22 of the 31 sources. The data clearly demonstrated that ability of GAC to remove a wide range of organic compounds from the water. Trichloroethylene and tetrachloroethylene were the most frequently detected compounds. Experience suggests that the downflow fixed bed is more cost-effective than a pulsed-bed for groundwater treatment. At 22 of the sites, treatment of groundwater prior to carbon adsorption was not required. These contaminated supplies were stable and contained low concentrations of suspended solids which could be removed in the carbon bed without hindering adsorption or creating a high pressure drop. Contact time is a particularly important design parameter for any adsorption system. To improve carbon efficiency where longer contact times are needed, two adsorbers are usually required. Operating costs with GAC treatment are dependent on a number of factors including flow rates, concentration and type of organics, type of applications, sites requirements, timing requirements, and length of the processing project. As expected, the operating costs for GAC treatment was lower in the case of those projects with lower average influent levels of contaminant. (Baker-IVI)
W84-01323

PROTECTIVE PONDS SAVE ECORSE CREEK,
Wade, Trim and Associates, Inc., Taylor, MI.
D. R. Trim.
Water Engineering and Management, Vol. 130, No. 6, p 48-50 and 58, June, 1983. 3 Fig, 1 Tab.

Descriptors: *Sewer systems, *Settling basins, *Combined sewer overflows, Overflow channels, Construction, Water pollution control, Aeration.

Serious combined sewer overflow problems in several Michigan communities have been solved through the institution of two large retention basins, one covered and incorporating a jet aeration system, and one open. The less expensive, the open stormwater basin, was built under a $2,396,576 construction contract and required about 612,000 cu yd of earth excavation along with the installation of a pumping station, 2,000 ft of 8-in to 60-in diameter sewer and 900 ft of relocation water main. A sewer separation project under another contract routes storm water to it through 7,000 ft of 54-in to 132-in diameter reinforced concrete pipe. The enclosed retention basin was built for $6,489,256 as a 530 ft long by 190 ft wide structure extending 25 ft below grade. Up to about 22,000 gpm of the pumping station's capacity can be used to keep solids in the wastewater stored in the basin in suspension. Constructed at the downstream end of the 54-in interceptor that routes combined flows out of the Ecorse Creek basin, the retention structure is designed to go on-line when flows rise above the 14.2 cfs level, storing up to 13 mil gal of wastewater in both of its chambers if necessary. Since its use, basement flooding was eliminated and the pollution of the creek has been drastically reduced. (Baker-IVI)
W84-01325

A CONCEPTUAL FRAMEWORK FOR MEASURING THE BENEFITS OF GROUNDWATER PROTECTION,
Environmental Protection Agency, Washington, DC. Office of Policy Analysis.
R. L. Raucher.
Water Resources Research, Vol. 19, No. 2, p 320-326, April, 1983. 4 Tab, 15 Ref.

Descriptors: *Groundwater protection, *Cost-benefit analysis, Policy making, Groundwater pollution, Waste disposal, Water use, Geohydrology.

There is an increasing concern regarding the contamination of groundwater by hazardous materials. This concern is now being translated into private and public sector initiatives to implement waste disposal and other policies designed to protect groundwater. These activities generate substantial costs; the purpose of this paper is to establish a framework with which to measure the benefits of such efforts to protect groundwater. This benefits framework is based on the premise that the probabilistic value of protection is at least as great as the expected costs of contamination. These costs are shown to be sensitive to a variety of site-specific hydrogeologic and water use factors and general economic parameters. By facilitating benefit-cost comparisons, the framework provided here should help direct groundwater protection resources to their most efficient uses. (Author's abstract)
W84-01337

INCORPORATING THE STOCHASTIC NATURE OF WATER QUALITY INTO MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. C. Ward, and J. C. Loftis.
Journal of the Water Pollution Control Federation, Vol. 55, No. 4, p 408-414, April, 1983. 1 Fig, 30 Ref.

Descriptors: *Water quality management, *Stochastic process, Hydrologic cycle, Water quality standards, Statistical methods, Sampling, Monitoring, Networks.

Water quality in a stream or river is the result of two primary causal mechanisms: the activities of society, and the natural hydrologic cycle. Water quality management must deal with both, even if it does attempt to control only one - the activities of society. Both mechanisms may be described as stochastic processes in that each, to some degree, is governed by the laws of chance. Thus, water quality, from a broad management perspective, can be considered a random variable. While past water quality management efforts were soundly based on the state-of-the-art knowledge of the time, the new knowledge must now be incorporated into the management structure, or the structure must be modified to reflect the new knowledge. Several of the implications to management of incorporating concepts of water quality hydrology and statistical sampling are reviewed. Water quality standards should be interpreted in relation to probabilistic information derived from a statistically designed and operated, fixed-station monitoring network. (Moore-IVI)
W84-01397

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WAYS TO INCREASE THE EFFICIENCY AND RELIABILITY OF OPERATING HYDROELECTRIC STATIONS WITH MULTIPURPOSE RESERVOIRS,
For primary bibliographic entry see Field 8C.
W84-01065

USE OF RECREATION ANALYSIS IN RESOURCE MANAGEMENT: A CASE STUDY,
Massey Univ., Palmerston North (New Zealand). Dept. of Agricultural Economics and Farm Management.
B. S. Harris, and A. D. Meister.
Journal of Environmental Management, Vol. 16, No. 2, p 1117-124, March, 1983. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Recreation facilities, *Resources management, *Lakes, Resource allocation, Economic evaluation, Cost-benefit analysis, Decision making.

The value of specific recreation sites is often an important consideration in resource management. The aim of recreation analysis is to derive a monetary value for such sites, providing a comparative figure for efficient resource allocation between alternative uses. The paper summarizes a particular recreation analysis carried out on a lake in the North Island of New Zealand. The methodology is based on the accepted travel cost approach which provides an estimation of the consumers' surplus associated with visitation to a public good type recreational amenity. The results of the study are discussed in relation to their usefulness in resource management decision-making and applicability to cost-benefit type economic evaluations. (Author's abstract)
W84-01210

ECONOMIC RESOURCE MULTIPLIERS FOR REGIONAL IMPACT ANALYSIS,
Max C. Fleischmann Coll. of Agriculture, Reno, NV. Div. of Agricultural Economics.
T. R. Harris, and C. T. K. Ching.
Water Resources Bulletin, Vol. 19, No. 2, p 205-210, April, 1983. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Economic aspects, *Income, *Water use, *Model studies, Regional development, Employment, Nevada.

Tradeoffs between regional economic development and resource use is a question often confronting local decision makers. A resource-interindustry model can be used to depict the interrelationships between regional economic sectors as to household income and/or employment and resource use. A resource-interindustry model was developed for Humboldt and Lander Counties in Nevada which shows the tradeoffs between regional household income (wages, salaries, profits, and rents) and/or employment and water usage. Water income and water employment multipliers can be ranked, enabling decisionmakers to realize sectors which require greatest regional water usage to regional household income and/or employment. (Author's abstract)
W84-01286

SOFTWARE SOLVES WATER SUPPLY PROBLEMS,
For primary bibliographic entry see Field 5F.
W84-01321

6B. Evaluation Process

REGIONAL VERSUS LOCAL WATER SUPPLY PLANNING,
Corps of Engineers, Baltimore, MD. Baltimore District.
J. E. Crews.
Journal of Water Resources Planning and Management, Vol. 109, No. 2, p 179-185, April, 1983. 2 Fig, 1 Tab.

Descriptors: *Regional planning, *Water supply development, *Metropolitan water management, Cost analysis, Local governments, Water policy, District of Columbia, Metropolitan Washington D.C. area.

The Metropolitan Washington, D.C., area water supply study being conducted by the U.S. Army Corps of Engineers presents an approach in planning for water supplies that can lead to regional management. The challenge, however, rests with the local decision-makers in seeing that a management plan is adopted for the Metropolitan Washington area. Unfortunately, local governments find themselves in a dilemma revolving around the economic and self-sufficient nature of governance. This paper explains how the Metropolitan Washington area has reached a point when new supplies must be developed. The area's supply base is a finite resource where previous independent actions have not caused any serious problems. Now there are obvious advantages in cooperating to develop a regional water policy as well as sharing in the development of cost-effective solutions. (Author's abstract)
W84-01141

THE ENVIRONMENTAL MONITORING PROGRAM FOR THE WATERSHED OF THE GREAT POND AND RICHARDI RESERVOIRS,
Stone and Webster Engineering Corp., Boston, MA.
J. D. Cleggett.
Journal of the New England Water Works Association, Vol. 97, No. 2, p 119-133, June, 1983. 8 Fig.

Descriptors: *Watershed management, *Reservoirs, Water supply development, Groundwater mining, Water shortage, Surface drainage, Groundwater reservoirs, Wetlands, Reservoir evaporation, Massachusetts, Great Pond Reservoir, Richardi Reservoir.

The towns of Braintree, Randolph, and Holbrook in Massachusetts consume water from the Great Pond Reservoir and the relatively new Richardi Reservoir. The water is basically runoff water from a 10 sq mi watershed comprised of four major wetland areas, connected by a system of brooks and rivers. The drought condition existing since the beginning of 1980 has caused a reduction in supply, forcing the town to impose restrictions on the use of water and to prepare emergency plans to augment the supply. Baseline data about the watershed is used to identify adverse changes and to initiate corrective action directed towards maintaining the area in its present or improved condition. Precipitation is measured daily for each 24 hr period, and is used to indicate the present pattern of rainfall. The inflow to the reservoirs is continually measured to indicate how much water is collected, how long it takes the wetlands to drain into the reservoirs, and how much water comes from each collection area. Once it has been determined which rivers are the major sources, clean-up efforts can be concentrated on those first. Daily consumption is also recorded so as to prepare a projection of future demands. Evaporation is calculated daily for each reservoir to aid in determining whether covers over reservoirs will offer significant help. Water quality throughout the watershed is tested monthly and the entire watershed area is inspected monthly. The second aim of the study is to develop a proposed project to increase the source of supply. A project has been presented and work has begun to excavate certain areas of the Richardi Reservoir which it is believed will intersect groundwater below the Reservoir. Estimates indicate the yield from this new source could be as high as 4 million gpd. (Baker-IVI)
W84-01158

PRIVATIZATION OF WASTEWATER TREATMENT,
Young (Arthur) and Co., New York.
For primary bibliographic entry see Field 5F
W84-01315

6D. Water Demand

WATER ALLOCATION CONFLICTS ON CANADIAN PRAIRIES.
Manitoba Univ., Winnipeg. Dept. of Civil neering.
I. C. Goulter, and B. Webb.
Journal of Water Resources Planning and Ma ment, Vol. 109, No. 2, p 147-164, April, 19 Fig, 3 Tab, 20 Ref.

Descriptors: *Competing use, *Water demand rigation water, *Resources development, *H electric power, *Canada, Prairies, Consum use, Water allocation, Water shortage.

The conflicts between water demands for e production and irrigation development on th nadian prairies and the available supply ar viewed. The water requirements for energy duction in the western provinces of Alberta Saskatchewan arise from the development sands and heavy oil. Manitoba has a large am of developed and potential hydroelectric capa While a considerable area in the prairies is pre ly irrigated, a very large increase in irrigated is possible in the forseeable future. All major r in the prairie provinces flow from west to Consumptive uses in the western parts of region reduce the potential for water-based d opments in the east. Ground water is not a fea source of supply across much of the region water allocation agreement is currently in among the three provinces. While there are problems apparent with the present alloca areas of potential conflicts have been identifie growing imbalance between supply and dem suggests that increasingly severe water short may be anticipated in many areas in the future. (Author's abstract)
W84-01145

WELLESLEY'S WATER PROGRAM PL NING; DEMAND STRATEGY,
Massachusetts Dept. of Public Works, Welle Hills.
M. R. Berdan.
Journal of New England Water Works Ass ation, Vol. 97, No. 2, p 82-89, June, 1983.

Descriptors: *Water demand, *Massachuse Wellesley, Public opinion, Public participat Pricing, Regulations, Seasonal variations, W supply development.

Two so-called 'demand strategies' have been plemented in Wellesley, Massachusetts, aimed keeping water consumption within the same yi as the system, rather than increasing the supply water to meet rising demands. The first strategy seasonal, peak demand pricing and the second citizen education program centered around a su mertime Odd-Even outdoor watering system. Bo strategies stress use of simple, low cost, creat approaches to buy time, improve product relia ity and enhance public image. Wellesley is prim ily a residential community with about 27,0 people in 8,000 homes spread over 10 sq mi. T water supply consists of seven wells and a 143 distribution system with two sets of covered res voirs with a combined storage capacity of million gallons. The system is fully metered, w 75% of the water going to residential custome and 25% to commercial/municipal users. The cu rent supply of 5.2 million gallons a day is n sufficient to meet present and future peak d demands. The seasonal peak demand rate begun June of 1981 creates a sharply inverted season peak demand rate structure for all custome during the period of May through September. Th unit cost for peak summer consumption is substa tially higher than the regular rate, thus serving an effective deterrent against high consumptio The key to the success of citizen education effor is public awareness, public acceptance and suppor and public participation. The results thus f

suggest that the water conservation and strategies can work and their success re- very large and broad based constituency. ategies are easily implemented, with prom- g term implications. (Baker-IVI)
56

ater Law and Institutions

D WATER AND FEDERAL RESERVED
Univ., Reno. Dept. of Civil Engineering.
d.
f Water Resources Planning and Manage- ol. 109, No. 2, p 174-178, April, 1983.

ors: *Groundwater, *Water rights, *Legal *Federal jurisdiction, Political aspects, Ri- ights, Reasonable use, *Reserved rights.

as been a great deal of concern in the United States regarding the concept of y reserved water rights. Groundwater he origin of Federal powers regarding ghts, and the groundwater rights of feder- rved lands are reviewed. The Federal gov- may, as a landowner, use the groundwater other landowner, following the riparian the common law of England. The federal ent would not be subject to any more ns than any other user since it could be hat the Federal use of water was a reason- for a reasonable purpose. In states that ne appropriation doctrine the Federal gov- may, on or for reserved or withdrawn aim a reserved groundwater right with a date as of the creation of the reservation. t is limited, of course, by the amount of ailable and limited to fulfill the purpose of rvation. Any water planner must consider ved rights of the Federal government and e both there existence and the potential of claim of senior priority. (McKeon-IVI)
40

RES OF FEDERAL LAW THAT EN- GE ADOPTION OF LAND APPLICA- F WASTEWATER,
in Univ.-Madison. Law School.
mary bibliographic entry see Field 5G.
43

REMENTS FOR WASTEWATER HAN- SYSTEMS: SECOND-ROUND UPDATE,
aler, and P. K. Sinha.
Engineering, Vol. 87, No. 8, p 54-55, 1983. 1 Tab.

ors: *Regulations, *Wastewater manage- Powerplants, Industrial wastes, Chlorina- ash, Cooling water, Runoff.

cts that the recently promulgated second- mitations will have in the establishment of ents for wastewater handling systems are d. These second-round regulations identify lant discharge categories subject to federal ns including once-through cooling water, ating cooling water system blowdown, ash t water, chemical based metal cleaning and coal pile precipitation runoff. The limi- are specifically aimed at control of the e of free available chlorine, pH, total sus- solids, oil/grease, copper, iron, and poly- ted biphenyl compounds. Specific rules for tion of cooling waters also are established. of the costs that would be associated with analyses to demonstrate compliance with detectable discharge limit, the EPA has to allow the permit-issuing authority the f accepting mass balance calculations as an ive. (Baker-IVI)
235

6G. Ecologic Ir ... Of Water Developmen

INDEX OF HABITAT DISTURBANCE FOR LAKESHORE COTTAGE DEVELOPMENT,
Ontario Ministry of Natural Resources, Toronto. Wildlife Branch.
G. Racey, and D. Eueler.
Journal of Environmental Management, Vol. 16, No. 2, p 173-179, March, 1983. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Land use, *Land development, Habitats, Environmental effects, Lake shores, Vegetation effects, Runoff, Water quality.

An index is identified that can be used to quantify habitat changes resulting from lakeshore cottage development. Characteristics of cottage lots in central Ontario are also discussed. An Area Development Index (ADI) was calculated using variables obtained from the area disturbed in the ground, shrub, and tree layers. The area of disturbed habitat in the three vegetation layers varied significantly ($p<0.01$) with lot size, and the area cleared in the shrub layer was significantly larger ($p<0.05$) than that cleared in the ground or tree layer. The mean number of buildings on a lot was 2.2 (+ or - 0.9), and their mean distance from the water was 20.0 m (+ or - 12.3). These differences were not significant. Small lots (<0.2 ha) can be expected to have a large ADI value. As the lot size increases there is an expected increase in the amount of undisturbed area on the lot. The major factor affecting wildlife, runoff, or water quality is not usually the presence of the cottage itself, but the residents activities and the destruction of habitat associated with cottage construction. The defined relationship between lot size and the ADI makes it possible to predict the proportion of area disturbed by development. (McKeon-IVI)
W84-01208

TEMPERATURE DISTRIBUTION AROUND A WELL DURING THERMAL INJECTION AND A GRAPHICAL TECHNIQUE FOR EVALUATING AQUIFER THERMAL PROPERTIES,
D'Appolonia Consulting Engineers, Inc., Pittsburgh, PA.
C.-S. Chen, and D. L. Reddell.
Water Resources Research, Vol. 19, No. 2, p 351-363, April, 1983. 13 Fig, 2 Tab, 43 Ref.

Descriptors: *Thermal injection, *Heat transfer, Confined aquifers, Conduction, Convection, Mathemetical models, Thermal conductivity, Caprock, Injection wells.

Analytical solutions of temperature distribution are developed for the problem of thermal injection into a confined aquifer with a caprock of finite thickness. Heat transfer by horizontal conduction and convection within the aquifer and by vertical conduction in the caprock and bedrock is considered. Steady state and two asymptotic unsteady state solutions of temperature distribution around a thermal injection well are determined. One unsteady state solution is for short time periods and the other is for long time periods. The caprock thickness is only important in the long time period solution. A graphical technique is presented using hypothetical data for evaluating four pertinent aquifer thermal properties: (1) the horizontal thermal conductivity of the aquifer, (2) the thermal capacity of the aquifer, (3) the vertical thermal conductivity of the caprock, and (4) the thermal capacity of the caprock. Field measurements of aquifer temperatures near the steady state condition are theoretically needed to utilize the graphical technique. In many practical situations a long time period is required to achieve a steady state condition. Therefore, a modified graphical technique employing an unsteady temperature distribution is illustrated and can be used to estimate the horizontal thermal conductivity and aquifer thermal capacity. (Author's abstract)
W84-01362

SEASONAL LIMNOLOGICAL CHANGE AND PHYTOPLANKTON PRODUCTION IN GHA-
KURI, A HYDRO-ELECTRIC LAKE ON THE WAIKATO RIVER,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W84-01372

7. RESOURCES DATA

7A. Network Design

APPLICATION OF NETWORK DESIGN PROCEDURES FOR REDESIGNING KIZILIRMAK RIVER BASIN RAINGAUGE NETWORK, TURKEY,
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
U. Sorman, and G. Balkan.
Hydrological Sciences Journal, Vol. 28, No. 2, p 233-246, June, 1983. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Rain gages, *Network design, Rainfall distribution, *Turkey, Hydrologic data, Kizilirmak River basin.

Recently developed rainfall network design techniques are discussed and compared. Present day hydrological studies require high levels of accuracy from collected data. Also, scientists need to know the degree of accuracy of the information they use. The existing rainfall network in the Kizilirmak basin must be redesigned in order to meet the required level of accuracy preset by rainfall data users. The three following techniques were applied: optimum interpolation procedure which is a flexible method; variance of mean areal rainfall; and the analysis of variance. The existing network of 52 gauges is redesigned so that the network will have an average root mean square error (rmse) of < 32 mm and the percentage of the area with rmse > 36 mm is limited to 10%. The proposed criteria are satisfied by a network of 53 gauges of which eight were newly established and seven of the existing ones removed. (Author's abstract)
W84-01100

GROUNDWATER OBSERVATION NETWORK DESIGN FOR THE KANSAS GROUNDWATER MANAGEMENT DISTRICTS, U.S.A.,
Kansas State Geological Survey, Lawrence.
M. Sophocleous.
Journal of Hydrology, Vol. 61, No. 4, p 371-389, 1983. 9 Fig, 1 Tab, 13 Ref.

Descriptors: *Network design, *Groundwater level, Observation wells, Groundwater management, Water table, Economic aspects, Kansas.

Concerns about the efficiency and economic soundness of the Kansas groundwater monitoring program led to a systematic redesign of this network, a tentative phase of which is presented in this study. The objectives of this paper include monitoring of major aquifers within each groundwater management district at a spatially more uniform level of accuracy, elimination of redundant measurements and optimization of the information gained from each observation well. The theory of regionalized variables is employed to estimate the amount of spatial variability of the water table, on which the network design is based. This study shows that it is not practical to attempt to reduce the already existing level of uncertainty uniformly throughout the various districts; to do so would tremendously increase the cost of well monitoring, which is already very high. Assuming that the currently existing network is satisfactory for the State's objectives, a reduced network consisting of one well every 6.4 km is equally satisfactory. The reduced network yields district-wide maps that do not differ significantly from those produced using the present network and at the same time it reduces the already-existing network by 18-47%. Therefore, adoption of a rearranged square well network is recommended, which is reduced to a 6.4-km spacing to achieve both a uniform level of information about the water table and a minimum required accuracy. (Author's abstract)
W84-01216

VELOCITY EQUATION FOR WATER QUALITY MODELING IN GEORGIA,
Georgia Dept. of Natural Resources, Atlanta. Environmental Protection Div.
For primary bibliographic entry see Field 5A.
W84-01277

7B. Data Acquisition

ORGANIZATIONAL NEEDS FOR HYDROLOGICAL APPLICATIONS OF SATELLITE REMOTE SENSING IN DEVELOPING COUNTRIES,
Bristol Univ. (England). Dept. of Geography.
E. C. Barrett.
Hydrological Sciences Journal, Vol. 28, No. 2, p 273-281, June, 1983. 2 Tab, 9 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Hydrologic data, *Rainfall, Institutional constraints, Political constraints, *Developing countries.

Remote sensing has great, but largely unrealized, potential in operational hydrology especially in countries where conventional data are not adequate even to meet existing needs. It is argued that organizational, not physical, problems have been the most significant in limiting the spread of satellite remote sensing applications for hydrology within the developing world. Looking to the future, the relative merits of tactical ('bottom up') and strategic ('top down') approaches for the promotion of satellite remote sensing for hydrology in such areas are outlined and discussed. Existing and proposed International Hydrological Program projects may proffer some suitable channels through which significant progress could be made. (Moore-IVI)
W84-01103

WEATHER STATION SITING AND CONSUMPTIVE USE ESTIMATES,
Idaho Univ., Kimberly. Twin Falls Research and Extension Center.
For primary bibliographic entry see Field 2B.
W84-01144

USE OF HIGH HORIZONTAL RESOLUTION SATELLITE TEMPERATURE AND MOISTURE PROFILES TO INITIALIZE A MESOSCALE NUMERICAL WEATHER PREDICTION MODEL - A SEVERE WEATHER EVENT CASE STUDY,
Australian Numerical Meteorology Research Centre, Melbourne.
G. A. Mills, and C. M. Hayden.
Journal of Climate and Applied Meteorology, Vol. 22, No. 4, p 649-683, April, 1983. 19 Fig, 33 Ref.

Descriptors: *Weather forecasting, *Satellite technology, Midwestern United States, Moisture profiles, Storms, Model studies, Remote sensing, Forecasting, Prediction, Model testing.

Sub-synoptic resolution satellite-derived temperature and moisture profiles have been assimilated into a mesoscale numerical weather prediction model. This model is intended for use in forecasting the environment of organized convective storm complexes in the midwestern section of the United States. The domain of the analysis covers most of the North American continent, as well as adjacent areas of the Atlantic and Pacific Oceans. The scheme uses a combination of the successive correction method (SCM) of Cressman and the variational blending techniques of Sasaki. Two characteristics make it particularly suitable for the objective analysis of satellite temperature profiles: the geopotential thickness is a primary analysis variable, making it a wind from mass scheme, and secondly, differing weight can be given to scalar and gradient geopotential information during the variational blending procedure, thus allowing the geopotential gradient information inherent in the satellite temperature data sets to be used more effectively. Assimilation of high horizontal resolution satellite temperature data sets into a mesoscale numerical weather prediction model produced short term forecasts with a promising level of skill. The forecasts show a good level of accuracy as compared with high resolution rawinsonde data. The high horizontal resolution of the satellite data contributes to the accuracy of the forecast through the model's ability to retain details of the initialization. (Baker-IVI)
W84-01168

EVALUATION OF A DEPTH PROPORTIONAL INTAKE DEVICE FOR AUTOMATIC PUMPING SAMPLERS,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. E. Eads, and R. B. Thomas.
Water Resources Bulletin, Vol. 19, No. 2, p 289-292, April, 1983. 3 Fig, 5 Ref.

Descriptors: *Intakes, *Water sampling, *Suspended sediments, Pumps, Water depth, Sampling.

A depth proportional intake boom for portable pumping samplers was used to collect suspended sediment samples in two coastal streams for three winters. The boom pivots on the stream bed while a float on the downstream end allows debris to depress the boom and pass without becoming trapped. This equipment modifies point sampling by maintaining the intake nozzle at the same proportion of water depth regardless of stage. Data taken by pumping samplers with intakes mounted on the boom were compared with depth integrated hand samples. Pumped samples showed higher concentrations than depth integrated hand samples. Results suggested that cross-sectional sampling can give high precision with proper placement and calibration of a boom mounted intake. (Author's abstract)
W84-01274

EFFECTIVE USE OF LANDSAT IN HYDROLOGIC MODELS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. Rango, A. Feldman, T. S. George, III, and R. M. Ragan.
Water Resources Bulletin, Vol. 19, No. 2, p 165-174, April, 1983. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Hydrologic models, *Discharge frequency, *Satellite technology, *Cost analysis, Hydrologic cycle, Data interpretation, Land use, Remote sensing, Watersheds.

In a cooperative demonstration project, NASA and the U.S. Army Corps of Engineers (Corps) compared conventional and Landsat-derived land-use data for use in hydrologic models, and the resulting discharge frequency curves were analyzed. When a grid-based data-management system was used an a cell-by-cell basis (size about 1.1 acres or 0.45 hectare), Landsat classification accuracy was only 64%, but, when the grid cells were aggregated into watersheds, the classification accuracy increased to about 95%. When both conventional and Landsat land-use data were input to the HEC-1 model for generating discharge frequency curves, the differences in calculated discharge were judged insignificant for subbasins as small as 1.0 sq mi (2.59 sq km). For basins larger than 10 sq mi (25.9 sq km), use of the Landsat approach is more cost-effective than use of conventional methods. Digital Landsat data can also be used effectively by local and regional agencies for hydrologic analysis by incorporating the data into grid-based data-management systems. The transfer of this new technology is well under way through inclusion in some Corps training courses and through use by both county government personnel and private consultants. (Author's abstract)
W84-01291

GROWTH RESPONSE AND SPECTRAL CHARACTERISTICS OF A SHORT SPARTINA ALTERNIFLORA SALT MARSH IRRIGATED WITH FRESHWATER AND SEWAGE EFFLUENT,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W84-01299

USE OF CHROMATICITY IN REMOTE
UREMENTS OF WATER QUALITY,
For primary bibliographic entry see Field 5A
W84-01300

DISCRIMINATION OF GROWTH
WATER STRESS IN WHEAT BY VA
VEGETATION INDICES THROUGH C
AND TURBID ATMOSPHERES,
Agricultural Research Service, Phoenix
Water Conservation Lab.
For primary bibliographic entry see Field 2I
W84-01305

KEEPING TABS ON EXCESS CHLORINE
C. W. Inghram.
Water Engineering and Management, Vo
No. 4, p 36-38, April, 1983. 4 Fig.

Descriptors: *Pollutant identification, *Mea
instruments, *Chlorine, *Colorimetry, Wast
treatment, Quality control, Bacteria, Disinf

A new on-line instrument for measuring the
rine content in effluent - the Pump-Color
Total Chlorine Analyzer - was field tested
ability to monitor chlorine residual in a
wastewater stream. The instrument was so
because of the way its glass colorimeter cel
tions as a cylinder for the sample transport
The unit synchronizes reagents and sample p
so that the DPD (N,N-diethyl-p-phenyle
mine) colorimetric chlorine reagent and buff
added confluently to the water sample.
optical system, light is transmitted through a
ing lens and through the reacted sample
pump cyclinder. A second lens focuses trans
light through a beam splitter which reflects
10% of the light toward a color filter and
ence photocell. The remaining light is trans
toward another filter and measuring phot
The difference between the photocell outpu
nals is conditioned electronically to prov
linear output which drives the meter and an
nal recorder on the analyzer dial and can be
mitted to recorders and alarm systems. The
indicator contains iodide and a buffer solutio
develops a pink color proportional to the a
of total chlorine in a sample. Bacterial gr
inhibitors prevent microbial fouling of the
ment. Since installation of the instrument, sm
automatic monitoring has become routine a
waste treatment plant. (Baker-IVI)
W84-01319

FLUORESCENT DYE AIDS DISTRIBUT
STUDIES,
Army Environmental Hygiene Agency,
McPherson, GA.
D. Grasso, and R. C. Williams.
Water Engineering and Management, Vol.
No. 4, p 40-41 and 50, April, 1983. 4 Fig, 5

Descriptors: *Hydraulics, *Flow characteris
*Measuring instruments, Dyes, Dye releases, T
ers, Fluorometry.

The use of an impulse dye-tracer study as a m
of evaluating flor distribution structures is
scribed in analyses of hydraulic efficiency.
effectiveness of the method is predicted on the
of readily available equipment, consisting
fluorometer and a non-reactive dye. The pr
dure consists of injecting a dye into the pro
stream or into the flow distribution struc
(FDS). Dye concentration is then measured
each effluent stream over some period of time
resulting concentrations are plotted versus t
(dye-distribution curves) and the curve integra
for each stream. A modified mass balance is
performed to evaluate the hydraulic distribu
efficiency of the FDS. Dye selection is depend
upon process stream characteristics and is a crit
step in the technique. The most commonly u
dyes are fluorescent dyes such as Fluorescein, P
tacyl Pink B, Rhodamine B and Rhodamine W
Once selected, the injection concentration of a
is calculated according to the estimated flow ra
After injection, samples should be collected
regular time intervals. Aliquots of each sample

for fluorescence intensity with a fluoro-
e relationship between fluorescence in-
d dye concentration has been shown to
through derivation from the Beer-Lam-
er Law. Thus it is not necessary to de-
ndard curve in order to measure relative
e concentrations and only fluorescence
eed be recorded as a function of time.
I).
0

INATION OF SUCCESSIVE SAM-
PORTABLE PUMPING SYSTEMS,
uthwest Forest and Range Experiment
rcata, CA.
mas, and R. E. Eads.
sources Research, Vol. 19, No. 2, p 436-
, 1983. 4 Fig, 1 Tab, 5 Ref.

rs: *Water sampling, *Suspended sedi-
onitoring, Water quality, Particle size,
ntamination, Pumping samplers.

c discrete sample pumping systems used
r water quality should deliver to storage
als pumped in a given cycle. If they do
essive samples will be contaminated, a
oblem with highly variable suspended
concentrations in small streams. The
amination characteristics of two small
used portable pumping samplers are
to each other and to reference meas-
under conditions of sudden and severe
in suspended sediment concentrations.
sure-vacuum sampler showed greater
ntamination, especially when changing
to zero concentrations, than the peristal-
er. Both samplers, however, cross-con-
to some degree. The contamination was
due to the sand size particles rather than
r sizes. (Author's abstract)
3

aluation, Processing and
ation

ROUTING ON A SMALL COMPUTER,
xico Univ., Albuquerque. Dept. of Civil
ng.
gen.
ineering, Vol. 53, No. 3, p 63-68, March,
g.

rs: *Flood routing, *Computer pro-
Flood hydrographs, *Open-channel flow,
scharge relations, Water conveyance,
r models, Reservoir releases.

BASIC program has been designed for
flood routing data on small computers.
hydrographs, computed by the Muskin-
nod, and reservoir hydrographs, calculat-
e Puls procedure, are utilized for these
uting determinations. Program data re-
ts also include Muskingum time constant
ghting values for channels, stage-dis-
orage rating curve coordinates for reser-
d a sequential listing of member con-
This program is also suited for analyses of
nnel conveyance systems, flood detention
s, and combinations of the two. Flow is
in the model to provide steady-state
y with initial inflows into the headwater
. The BASIC program works its way
am in a channel and reservoir system,
g inflows at the top of each member and
low to the bottom. Program methodology
ed in detail with sample programs given.
s abstract)
89

AL WATER-USE INFORMATION
AM,
al Survey, Reston, VA.
ann, IV, J. E. Moore, and E. B. Chase.
f Water Resources Planning and Manage-
ol. 109, No. 2, p 186-194, April, 1983. 5

Descriptors: *Water use, *Information systems, *Data collections, Computers, Ground water, Surface water, Saline water, Consumptive use, Data acquisition, Data interpretation.

The National Water-Use Information Program is a cooperative program between the states and the Federal Government. The purpose of the program is to determine how much fresh and saline surface water and ground water is withdrawn and for what purpose, how much water is consumed during use, and how much water is returned to a water body (stream, lake, or aquifer) after use. To accomplish its purpose, the program's goals are to: (1) collect and compile water-use data; (2) develop and refine computerized water-use data systems at both the state and national levels; (3) devise new methods and techniques to improve the collection and analysis of water-use information; and (4) disseminate this information to those involved in establishing water resources policy and to those managing the resource. The program was established in 1977, when the Congress of the United States recognized the need for uniform information on water use and directed the U.S. Geological Survey to establish a program to complement the Survey's data on the availability and quality of the Nation's water resources. (Author's abstract)
W84-01142

8. ENGINEERING WORKS

8A. Structures

ZONE OF TENSILE STRESSES IN THE FOUNDATION OF A CONCRETE DAM (FROM OBSERVATION DATA),
For primary bibliographic entry see Field 8F.
W84-01067

CONSIDERATION OF THE UPLIFT PRESSURE OF WATER IN CALCULATIONS OF THE STABILITY OF CONCRETE DAMS ON ROCK FOUNDATIONS,
Yu. A. Fishman.
Hydrotechnical Construction, Vol. 16, No. 9, p 502-507, September, 1982. 4 Fig, 1 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 41-44, September, 1982.

Descriptors: *Dam design, *Dam foundations, *Uplift pressure, *Concrete dams, Dam stability, Rock foundations, Stability analysis, Dam safety.

It has been suggested that the coefficient of effective area of uplift on the bottom of concrete structures (alpha 2) is different in the prelimit and limit states of structures due to the fact that in the limit state, the foundation receives disturbances such that the bounds are ruptured, crack open, and the area of contact on the surface of failure decreases. Consideration of the total of uplift, which corresponds to a state of limit equilibrium, in calculations of the stability of concrete structures of rock foundations is inadmissible and leads to results contradicting dam design and operating practice. Correct consideration of uplift and a substantial decrease of the value of the coefficient alpha 2 makes it possible to obtain higher values of the stability factors of concrete dams or to achieve for the same reliability a decrease of their cost. The coefficient of effectiveness of transmitting uplift alpha 2 under various conditions should be studied. (Moore-IVI)
W84-01069

CALCULATION OF LININGS OF A SYSTEM OF PARALLEL ROUND TUNNELS,
N. N. Fotieva, G. Ya. Gevirts, A. K. Petrenko, and A. N. Kozlov.
Hydrotechnical Construction, Vol. 16, No. 9, p 520-525, September, 1982. 3 Fig, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'sfvo, No. 9, p 53-56, September, 1982.

Descriptors: *Tunnel construction, *Pressure, *Tunnel linings, Construction, Design criteria, Powerplants, Elastic properties, Linings, Tunnels.

A method for calculating linings of two identical, mutually influencing parallel round tunnels for the action of an internal pressure based on the solution of the two-dimensional problem of elasticity theory for a medium weakened by two identical supported holes has been generalized to the case of an arbitrary number of parallel round tunnels, with centers on the same line, which can have different diameters and linings of different thicknesses made of different materials. The proposed method of calculation was used by the Leningrad Branch of the All-Union Planning, Surveying, and Scientific Research Institute when developing the specifications of tunnels for one of the hydrostations. Results of calculations are given for the section near the powerhouse (five parallel tunnels) in the construction and operating periods. The moduli of deformation of the concrete for two loaded linings were assumed reduced with consideration of the formation of cracks. Three variations of the pressures were examined for calculating the linings in the operating period. The same method can be further generalized to the case when the centers of the tunnels do not lie on the same line. (Baker-IVI)
W84-01071

THE CARSINGTON SCHEME - RESERVOIR AND AQUEDUCT,
P. G. Davey, and P. G. Eccles.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 3, p 215-239, June, 1983. 6 Fig, 3 Tab.

Descriptors: *Water supply development, *Reservoirs, *Aqueducts, *Pumped storage, *England, Reservoir design, Earth dams, Gravity flow, Flow augmentation.

The Carsington reservoir scheme is being developed to increase the water resources of the Severn-Trent Water Authority in the East Midlands, England. During the winter periods, water will be abstracted at the Ambergate pumping station and pumped to Carsington reservoir. In dry weather, when there is insufficient flow in the river to meet increased demand, water will be released from the reservoir and will flow by gravity to Ambergate where it will return to the river by way of the existing intake works. Water for north-east Derbyshire will be taken at Ambergate via Ogston reservoir and for the rest of the area, at Little Eaton. Provision has also been made to discharge water from the reservoir to the river Dove to augment flows to the Dove reservoirs as necessary. The dam site is unsuitable for any form of concrete dam due to the depth required for the foundations to be in unweathered strata, but is well suited for an earthfill dam, using local clays and shales. An aqueduct 10.5 km long, nearly all in tunnel, will connect the reservoir and the river Derwent. The tunnel will have a diameter of 2.3 m and will be lined with smooth bore reinforced concrete segments. The tunnels are needed to reduce the pumping head and the land disturbance and to permit gravity flow back to the river. (Moore-IVI)
W84-01075

SECONDARY FLOWS AND THEIR SIGNIFICANCE IN THE DESIGN AND OPERATION OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8B.
W84-01077

OPTIMIZATION OF GRAVITY-FED WATER DISTRIBUTION SYSTEMS: APPLICATION,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India).
For primary bibliographic entry see Field 8B.
W84-01106

SOME PROBABILISTIC ELEMENTS OF FIELD TESTING IN WATER DISTRIBUTION SYSTEMS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, S. Al-Nassri, and D. Clarke.
Proceedings of the Institution of Civil Engineers, Part 2, Vol. 75, p 143-153, June, 1983. 5 Fig, 19 Ref.

Group 8A—Structures

Descriptors: *Water conveyance, *Mathematical models, *Pipelines, *Pressure differential, Hazen-Williams equation, Field tests, Flow discharge.

Many engineering designs for water supply networks represent extensions to existing systems, so the determination of accurate estimates of the parameters for use in a mathematical model may be difficult since in some places a considerable deviation from newly constructed conditions develops. First order analysis (FOA) principles were used to examine the sensitivity of the pressure differential across several pipes due to uncertainties in the mathematical model, diameter, discharge, hydraulic exponent, and the Hazen- Williams coefficient. This information can be used to identify when considerable uncertainty exists in estimation of the pressure drop across a pipe and thus is an indication of whether a field-testing program may be warranted. The results obtained were also used to obtain an indication of the required accuracy of measurement devices for providing meaningful results in field measurements of pressure differentials along sections of distribution mains. (Moore-IVI)
W84-01247

MANHOLE INFLOW AND INFILTRATION STOPPED WITH SPECIAL REPAIRS,
Driver, Olson-Degraff and Associates, Rockford, IL.
F. T. Driver.
Water Engineering and Management, Vol. 130, No. 4, p 31-32, April, 1983.

Descriptors: *Infiltration rate, *Sewer infiltration, *Manholes, Sealants, Grouting.

Relatively new methods of manhole rehabilitation have substantially and economically reduced inflow and infiltration into the sewer collection network of Northbrook, Illinois. Damaged or poorly fitting manhole lids were replaced. Interior manhole restoration included replacing loose brick and mortar. Interior surfaces in the system were cleaned by high-pressure water jets. A chemically active cementitious material was applied to masonry surfaces to reduct further outflow. In those manholes where leaks were relatively few, pressure-grouting was used. Chemical grouting of precast structures, waterproofing of older brick structures, and lid repairs on just 170 of the village's manholes have reduced the total system infiltration and inflow by as much as 10%. (Wheatley-IVI)
W84-01318

8B. Hydraulics

DETERMINATION OF THE CROSS SECTION OF CANAL CHANNELS FOR SEDIMENT TRANSPORT,
Kh. Sh. Shapiro.
Hydrotechnical Construction, Vol. 16, No. 9, p 498-501, September, 1982. 2 Tab, 5 Ref. Translated from Gidroteckhnicheskoe Stroitel'stvo, No. 9, p 38- 40, September, 1982.

Descriptors: *Canals, *Channels, *Sediment transport, *Silting, Slopes, Channel morphology, Discharge capacity, *USSR.

A formula for selecting the slope and cross sections of a canal channel which provides passage of the design water discharges, dynamic stability of the channel, and sediment transport is given in two forms. One is for those cases when charging of the flow with fine sediment fractions is considerably below its transport capacity, which occurs in a considerable majority of canals with an intake from the Amu Darya, Syr Darya, Kura, and other rivers. The other method is for those relatively rare cases when the flow entering the canal is charged in excess of the transport capacity with all fractions, such as the Tedzen River. The slopes obtained by using this formula, especially in the case of large discharges, are slightly less than the slope in the water source. Nonsiltation of canals when the slopes are less than the river slope is confirmed by data from the Sukkur hydrodevelopment (Moore-IVI)
W84-01068

HYDRAULIC MODELING TODAY,
A. M. Prudovskii.
Hydrotechnical Construction, Vol. 16, No. 9, p 508-519, September, 1982. 5 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 47-53, September, 1982.

Descriptors: *Conferences, *Hydraulic models, Fluid mechanics, Computers, Channels, Erosion, Cavitation, Reynolds number, Froude number, Model studies, Hydraulics.

At the 19th Congress of the International Association of Hydraulic Research, 72 reports were offered at session D, Hydraulic Research and Modeling Techniques. The papers fitted into the following categories: criteria of correspondence of model and prototype; modeling in the case of several characteristic dimensionless numbers, e.g. Froude and Reynolds; new laboratory modeling techniques; new achievements in the area of instruments for laboratory and prototype investigations; and digital and analog computers as laboratory equipment. The problem of combining hydraulic (physical) and numerical modeling in hydraulic research was examined, bearing in mind that in both cases reference is to the solution of the problem by the modeling method with the use of different means. The selection of the modeling method in each specific case is determined by many circumstances, with the basic limitations of the possibility of their use being paramount. Attention was also given to the correspondence of the roughness of the stream channel on the model and prototype and to a problem related to distortion of the geometric scales. The effect of Re number on the discharge characteristic of a measuring flume was reported. The selection of the time scale of channel deformations and schematization of a transient hydraulic regime were studied. Cavitation erosion, groundwater flow measurements, discharge of warm water, new measuring instruments and methods, and use of a digital computer as a means of controlling an experiment were each reported on at the conference. A list of session D reports and authors is provided as an appendix to the review. (Baker-IVI)
W84-01070

EXWICK FLOOD RELIEF CHANNEL HEADWORKS,
M. C. Harries.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 3, p 243-250, June, 1983. 4 Fig, 1 Ref.

Descriptors: *Flood control, *Radial gates, *Bed load, Channels, Hydraulic design, Flow controls, Model studies, Accretion.

The Exeter Flood Protection Scheme was promoted in the early 1960s to protect the low lying parts of the city from a recurrence of the serious floods of 1960. A design was developed for the works at the head of the relief channel which controlled the distribution of flow between the river channel and the relief channel. Model studies indicated that when the flood flow was at the estimated formative discharge, 3,700 cusec would be discharged to the relief channel, leaving only 4,300 cusec in the river channel downstream from the headworks. The whole of the bed load would probably remain in the river channel, but the greatly reduced flow would be unable to carry it forward, and considerable accretion would take place. The capacity of the river channel could be increased to 9,000 cusec by raising the right bank. Calculations showed that a structure consisting of a central unrestricted flume 32 ft wide flanked on each side by a radial gate 34 ft wide could be operated to give the ideal distribution of all flows up to the design flood. The headworks have been constructed in accordance with the design and have operated up to about half the design flood. (Moore-IVI)
W84-01076

SECONDARY FLOWS AND THEIR SIGNIFICANCE IN THE DESIGN AND OPERATION OF HYDRAULIC STRUCTURES,
D. H. Simm.
Journal of the Institution of Water Engi
Scientists, Vol. 37, No. 3, p 251-256, June
Fig.

Descriptors: *Fluid mechanics, *Hydrauli
*Viscosity, Weirs, Piers, Sluices, Gates,
Boundary layers.

Secondary flow phenomena often cause di
in the smooth operation of hydraulic s
which could have been overcome during
This may result because basic equations
mechanics do not strictly apply to re
which possess viscosity, and the departu
theory are largely due to this fact. In ma
the variation from ideal behavior may be
can be allowed for by the application of
coefficient. In other cases, secondary eff
significant. Viscosity, the boundary laye
city, and the vortex effect should all be ta
consideration in the design of hydraulic st
Secondary flow effects are difficult to mo
factorily because viscous criteria determ
degree of turbulence induced. An inve
into local effects may require a model of
part of the scheme to a larger scale.
situations to which these factors should be
include: discharge under a control gate, d
over a compound weir, the approach to a
pier, and tunnel and sluiceway entries.
IVI)
W84-01077

**CONSERVATISM OF PROBABLE MAX
FLOOD ESTIMATES,**
Harza Engineering Co., Chicago, IL.
B.-H. Wang, and R. W. Revell.
Journal of Hydraulic Engineering, Vol. 109
p 400-408, March, 1983. 7 Tab, 14 Ref.

Descriptors: *Design floods, *Maximum p
floods, Safety engineering, Hydraulic desig
construction, Spillways, Safety, Flood
Precipitation, Design criteria, Floods.

Depending on the assumptions and data use
analysis, a probable maximum flood (PM
mate can vary over a significant range of
each associated with a certain degree of co
tism. A procedure is presented to determ
relative conservatism of a PMF estimate
will then enable engineers to determine h
PMF should be used in designing structura
major dams and spillways. The procedure
of assigning an index value for each fac
volved in the PMF estimate. Within the ra
each factor, the index value is selected su
the higher values reflect greater conser
Among the factors, the values are selecte
that they properly reflect the relative effect
factors on the PMF. The overall conserva
an estimate is then measured by the sum
individual index values. Of all the factors
(Probable Maximum Precipitation) is the m
portant. To demonstrate potential applicat
the concept, an example is given for a hypot
PMF estimate. If the estimated PMF has
index value of well over 100, consideration
be given to designing the structure for a s
flood unless there are reasons for an un
conservative design. If the total index value
below 100, the design engineer should p
necessary safety factors to ensure the safety
structure. (Baker-IVI)
W84-01097

**MOVEMENT OF FINE GRAINS IN TH
CINITY OF WELL SCREENS,**
Vizgazdalkodasi Tudomanyos Kutato Intez
dapest (Hungary).
G. Kovacs, and L. Ujfaludi.
Hydrological Sciences Journal, Vol. 28, No
247-260, June, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Soil suffosion, *Flow rate,
screens, Particle size, Velocity.

A great number of laboratory experiments
been performed to study the flow generated
sion process in soil samples supported by per
ed screens. Both parallel and radial flow

ypical example of the latter is a well-
orting the material of an aquifer). The
s tested were theoretically divided into
a coarse grained fraction which behaves
upporting skeleton, and a fine-grained
ing the pores of the skeleton. Experi-
ults showed that the process of soil
ccurs with increasing flow velocity. At
ies the fine grains maintain their origi-
n and the flow can be described by
v. Reaching a critical velocity vc1 the
start to move, partially plugging the
he skeleton, while resistance of the
ncreasing. Reaching a second critical
ity vc2 results in the development of
els, through which fine grains may
om the layer. The quantity of these fine
ends on the composition of the soil
flow rate and the slot-diameter of the
. On the basis of the experimental re-
ical formulae have been developed for
the critical velocities vc1 and vc2, and
m slot sizes of the screen. (Author's

ATION OF GRAVITY-FED WATER
TION SYSTEMS: APPLICATION,
ya Regional Coll. of Engineering,
dia).
e.
Environmental Engineering, Vol. 109,
3-395, April, 1983 2 Fig, 5 Tab, 7 Ref.

: *Water distribution, *Optimization,
low, *Linear programming, Systems
ater conveyance.

for the optimal design of multisource,
vity-fed water distribution systems sub-
a single loading pattern is illustrated
design example. The proposed method-
linear programming (LP) techniques for
nt purposes. Initially, an LP problem
the classical transportation problem is
and solved to obtain the design distri-
ph. This system is then optimized by
y formulating (if necessary) and solving
blem for obtaining the locally optimal
wo node labeling procedures have been
in the suggested methodology. This is
lone to develop the expressions for the
ign feasibility constraints. The transpor-
blem technique yields a unique design
graph. Once the design distribution
tained, the nonprimary links are locat-
the reliability of distribution increases,
f the network also slightly increases.
IVI)

G PROCESSES IN NAVIGABLE

Society of Civil Engineers, New York.
nittee on Causes and Effects of Shoaling
le Waters.
ai, J. Golden, Jr., W. H. McAnally, Jr.,
, and J. Neiheisel.
Waterway, Port, Coastal and Ocean
g, Vol. 109, No. 2, p 199-221, May,
3 Tab, 44 Ref.

: *Estuaries, *Shoals, *Navigable
aterways, Sedimentation, Harbors, Hy-
cs, Physicochemical processes, Sedi-
ort, *Shoaling processes.

ion processes in our nation's waterways
s are controlled by a complex array of
d chemical factors that are known only
terms. Evaluation of hydrodynamic
nd identification of null points are the
methods in predicting shoaling in navi-
nnels. Physicochemical processes con-
limentation are complex interactions of
solids and water chemistry which are in
ages of infancy in respect to our under-
nd interpretation. Because the bulk of
e dredging occurs in estuaries, and since
ocess concepts for estuaries can be ap-
stream and coastal areas, this study is concentrated on the shoaling processes common to estuaries. The estuary itself is a major source of shoaling material, perhaps even the primary source in many cases. Estuaries are sediment traps that are gradually filling with sediment. Manmade modifications can dramatically alter shoaling patterns by changing either the depositable sediment supply or the transport capacity. (Moore-IVI)
W84-01130

SEDIMENT SUSPENSION WITH RIPPLED BED,
Saitama Univ. (Japan). Dept. of Foundation Engineering.
S. Ikeda, and T. Asaeda.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 409-423, March, 1983. 13 Fig, 3 Tab, 11 Ref.

Descriptors: *Ripple marks, *Sediment suspension, *Turbulent flow, Vortices, Entrainment, Model studies, Eddies, Water currents, Statistical analysis.

Experiments on the suspension of sediment were performed in a flume with and without a sediment layer on the bottom. For movable bed runs, three-dimensional sand ripples were found to seriously affect the features of the suspended sediment. The horseshoe vortices and the resulting bursts in the lee of the ripples intermittently entrain a large amount of sediment into the outer layer of flow. Details of the suspension process were studied using a sand ripple model made of plaster. The result revealed that the vertical component of turbulent eddies is responsible for the suspension of sediment, and that the component is statistically described by the Gaussian distribution. The statistical distribution of the concentration fluctuation was observed to be highly skewed, and the reason was determined to be the fact that the concentration increases to the power of eight against the vertical fluid velocity. The period of the intermittent ejection of sediment agreed reasonably with those reported for natural geophysical flows. Thus, the suspension of sediment in flows with rippled beds was proven to be significantly correlated with bursting phenomenon behind sand ripples. (Moore-IVI)
W84-01131

DIFFERENCE METHODS OF FLOW IN BRANCH CHANNEL,
Academia Sinica, Shanghai (China). Shanghai Inst. of Computer Technology.
Z.-C. Li, L.-J. Zhan, and H.-L. Wang.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 424-446, March, 1983. 11 Fig, 7 Ref.

Descriptors: *Unsteady flow, *Branch channels, Tidal rivers, Flow characteristics, Channels, Flood flow, Mathematical studies, Hydraulic equations, *Yangtse River Branch Channel.

With the development of river transportation and water conservation construction, unsteady flows in branching channels need to be calculated frequently. A study was made of the methods of calculation. In order to compute the unsteady flow in a channel without branching, non-equidistant difference schemes on interior mesh points and the corresponding difference schemes on boundary mesh points have been developed. The branching of channels is a usual natural phenomenon. The Stoker method can be applicable only to the simple circumstance when the branch-point is basically stationary. In fact, the branch point of tidal river (or some inland rivers) is movable within a somewhat large area depending on the variation of tide height (or flood height). For the movable branch point, implicit and semi-implicit methods are provided. Both methods have already found their use in practical problems. (Moore-IVI)
W84-01132

UNIFORM REGION OF SELF-AERATED FLOW,
Canterbury Univ., Christchurch (New Zealand).
I. R. Wood.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 447-461, March, 1983. 11 Fig, 14 Ref.

Descriptors: *Spillways, *Aeration, Slopes, Velocity, Entrainment, Friction, Air concentration.

The measurement of air concentration and velocity obtained in the laboratory are compared with the recent prototype measurement obtained on Aviemore spillway. This comparison suggests that if a characteristic depth such as the depth at which the air concentration is 0.9 is chosen then the averaged air concentration over this depth is only a function of the slope. Similarly the air concentration distribution is also determined by the slope. The velocity distribution determined in the laboratory and in the field are also compared and it is suggested that water velocity measurements are consistent with a universal velocity distribution. These with the Darcy friction factor computed from laboratory results lead to a simple method for predicting the design parameters in the uniform aerated flow at the end of a long spillway. (Author's abstract)
W84-01133

FLOW NEAR GROIN-LIKE STRUCTURES,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and B. A. Nwachukwu.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 463-480, March, 1983. 8 Fig, 1 Tab, 16 Ref.

Descriptors: *Groins, *Turbulent flow, *Hydraulic models, Velocity, Deflection, Flow control, Model studies, Shear stress.

This paper presents the results of an experimental study on the structure of turbulent flow near groin-like structures. Based on experimental observations, the deflected flow has been analyzed using the model of the three-dimensional turbulent boundary layer. The flow bounded by the separating stream line, the groin, and the adjacent bank has been analyzed by treating it as a shear layer in which the velocity profiles have been found to be similar. The amplified bed shear stress near the groin has also been analyzed using the similarity idea. Even though the majority of the present experiments were done with the thin-plate groin, some observations were also made on a groin with a semicylindrical nose. (Author's abstract)
W84-01134

CLEAR-WATER SCOUR AT CYLINDRICAL PIERS,
Auckland Univ. (New Zealand).
A. J. Raudkivi, and R. Ettema.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 338-350, March, 1983. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Piers, *Scour, *Particle size, Bridges, Sediment transport, Bed sediment, Sediment erosion.

The results of laboratory experiments on the clear-water local scour of cohesionless bed sediment at cylindrical bridge piers are presented. The equilibrium depth of clear-water local scour is related to the grading of the bed sediment. In general, as the geometric standard deviation of the particle size distribution increases, the equilibrium scour depths decrease. The equilibrium depth of local scour decreases with the decreasing relative size of pier diameter to mean bed particle size for values less than about 20 to 25. The maximum equilibrium depth of clear-water local scour is a function of the relative depth (depth of flow/pier diameter) and the relative size (pier diameter/mean particle size). The equilibrium depth of local scour decreases at a greater rate with decreasing flow depth for smaller values of the relative flow depth. The decrease in the equilibrium depth is caused by to the interference of the water surface roller formed around the pier with the downwards flow into the scour hole. (McKeon-IVI)
W84-01138

CHANNEL MIGRATION AND INCISION ON THE BEATTON RIVER,
Wollongong Univ. (Australia). Dept. of Geography.
G. C. Nanson, and E. J. Hickin.
Journal of Hydraulic Engineering, Vol. 109, No. 3, p 327-337, March, 1983. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Bend migration, *Channel migration, Channel erosion, Flood plains, Forest succession, Channel width, Beatton River, *British Columbia.

New field data relating to bend migration rates with bend radius of curvature to channel width ratios (r sub m /w) for the Beatton River in British Columbia confirm the form of the relationship previously described, although there is more variance than initial results suggested. Recent data from forest successions on the floodplains of a variety of migrating rivers show that channel migration is a discontinuous process within any single bend. This means that predictions of migration rates for individual bends, based on short-term measurements using erosion pins or aerial photographs, are highly suspect. These variations in migration rate are likely a response to fluctuating channel widths over time because of a short-term imbalance between the rate of cutbank erosion and the rate of point-bar sediment accumulation. Finally the examination of new evidence of channel incision on the Beatton River shows that the river is downcutting at a rate of about 2 mm/yr, not at 10 mm/yr as reported earlier. (Moore-IVI)
W84-01139

WAVES IN MEANDERING STREAMS,
Michigan Univ., Ann Arbor.
C.-S. Yih.
Journal of Fluid Mechanics, Vol. 130, p 109-121, 1983. 2 Fig, 9 Ref.

Descriptors: *Wave propagation, *Stationary waves, Meanders, Spillways, Open channels, Froude number, Free surfaces, Mathematical models, Water depth.

Open water transport channels in mountainous regions often wind along contour lines of the terrain, and it has been observed that at a certain speed of flow waves of large amplitude form. Also, at the entrance of dam spillways, the contraction may create violent diamond pattern waves. Hence waves in meandering streams or in channels of variable width are of practical importance. Free-surface and internal stationary waves in a meandering stream are treated, and analytical solutions given. For each category there is an infinite number of Froude numbers, depending on the wavenumber of the meander, at which resonance occurs, and the amplitude of one of the wave components becomes infinite, according to the linear theory. These critical Froude numbers are interpreted physically. Variable depth is treated for the case of free-surface waves, and it is shown how the eigenvalues of a singular differential equation can be found under the requirement that the eigenfunction be non-singular. An attempt is made to explain the self-induced, non-stationary waves in water flowing between corrugated vertical walls, by an instability mechanism previously proposed. There is strong evidence that this mechanism is at work, at least when a sloshing mode is involved in the wave-triad interaction. (Moore-IVI)
W84-01239

STEADY SHALLOW FLOW OVER CURVED BEDS,
Asian Inst. of Tech., Bangkok (Thailand).
N. S. Sivakumaran, T. Tingsanchali, and R. J. Hosking.
Journal of Fluid Mechanics, Vol. 128, p 469-487, 1983. 12 Fig, 3 Tab, 11 Ref.

Descriptors: *Shallow flow, *Bed curvature, Critical flow, Froude number, Steady flow, Model studies, Mathematical models, Free surfaces, Bed pressure.

The validity of recent shallow-flow equations with bed curvature is examined. Subcritical, critical and supercritical steady-flow solutions are identified, and the point of critical flow on the bed located, in terms of a generalized Froude number. Experiments on steady flow over both a symmetric and unsymmetric bed profile show that the theory satisfactorily predicts the free-surface and bed-pressure profiles over -2 < or approximately = kh < or = 0.54 (where k is the bed curvature and h is the flow depth normal to the bed). (Author's abstract)
W84-01240

SETTLING QUIETS THE STORM EFFECTS,
Finkbeiner, Pettis and Strout Ltd., Toledo, OH.
G. G. Nixon, and G. L. Hoffman.
Water Engineering and Management, Vol. 130, No. 4, p 29-30, April, 1983.

Descriptors: *Clogging, *Filter media, *Storm water, *Silt load, Ohio, Water treatment facilities, Clarification, Lake Erie, Sedimentation basins.

On December 2, 1974, a severe storm swept across Sandusky, Ohio, on the south shore of Lake Erie. Sediment-laden runoff waters clogged the treatment facility, and the runs for the 12 filters were reduced to three hours. As a result of this occurrance, Sandusky began the construction of pre-sedimentation basins or tanks. Two aluminum dome-covered above-ground pre-sedimentation basins or tanks, each with a 100 foot inside diameter and providing 18 feet of water depth, were constructed. A three story Quick Mix building was built between them. Water is now pumped from the lake to this structure by a new variable frequency vertical turbine pump and an older, previously installed variable-speed pump, each with a capacity of 11.25 mgd. Raw lake water is flash-mixed with liquid alum in the Quick Mix facility and then transferred to the pre-sedimentation basins. These basins, operating in parallel, are of the flocculator-clarifier type, and additional mixing takes place within their skirts. Sludge settles to the bottom of the tanks and is discharged into sludge lagoons on the treatment plant site. The clarified water flows by gravity to the plant for further sedimentation and filtration. Now, during storm events when turbidity becomes extremely high, much of the excess solids immediately drop into the pre-sedimentation tanks, thus preventing the existing water treatment and filtration plant from being clogged. In addition, the media in six of the 12 existing filters was replaced. The pre-sedimentation project was completed in 1980, 26 months after construction began, at a total cost of 2.6 million dollars. (Wheatley-IVI)
W84-01317

FLUORESCENT DYE AIDS DISTRIBUTION STUDIES,
Army Environmental Hygiene Agency, Fort McPherson, GA.
For primary bibliographic entry see Field 7B.
W84-01320

8C. Hydraulic Machinery

WAYS TO INCREASE THE EFFICIENCY AND RELIABILITY OF OPERATING HYDROELECTRIC STATIONS WITH MULTIPURPOSE RESERVOIRS,
M. P. Fedorov.
Hydrotechnical Construction, Vol. 16, No. 9, p 479-483, September, 1982. 3 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 16-18, September, 1982.

Descriptors: *Reservoir operation, *Multipurpose reservoirs, *Hydroelectric plants, *Multivariate analysis, *Competing use, Water use, Long-term planning, Water management.

The operating regimes of hydroelectric stations with multipurpose reservoirs undergo considerable changes with time, which should be taken into account during design. In practice, it is very complicated to assess the changes in the regimes of water resources use for a particular reservoir more than 5-10 yr in the future. At present, about 20-25% of the installed capacity at hydroelectric stations is not used for a number of reasons, including 8-10% due to unplanned nonpower use in water-management systems. Intensification of nonpower water use substantially restricts the regimes of water energy use at stations with multipurpose reservoirs. It is necessary to conduct broad investigations of prospective operating regimes of such hydroelectric stations based on a multifacto sis of the water use conditions. It is expec examine new prospective operating regime at improving the quality and reliability power supply with the use of the installed c under conditions of reduced firm output fro tipurpose reservoirs. Technical and econom stantiation of prospective regimes should be on the development of organizational and te measures to maintain and provide reliabili efficiency of operation of the hydroelectric under more complex conditions of ope (Moore-IVI)
W84-01065

VIBRATION OF HYDRAULIC GATES,
J. Lewin.
Journal of the Institution of Water Enginee Scientists, Vol. 37, No. 2, p 165-179, April, 10 Fig, 30 Ref.

Descriptors: *Hydraulic gates, *Vibrations, draulic design, Turbulent flow, Flow chara tics, Seal leakage, Flow attachment.

Causes of flow-induced vibration in gates in seal leakage; flow attachment, shifting of the of flow attachment, and hydraulic dow forces; roller and turbulent flow downstrea gate; unstable flow through small openings over and under the leaves of a gate; unstabl approach in open channels due to changes i from three to two dimensional conditions; u control systems; instability due to lack of v and to two phase flow; problems associated reversed tainter gates or culvert valves; sl guide channels, pivots, guide wheels, hoist etc.; and the proximity of two gates. Design lines are presented for each of these cases. mation obtained from technical papers, tests, observations and analysis should be into account in designing gates and associated engineering works. The main emphasis shou be placed on strengthening a vibrating str but on creating hydrodynamic conditions a improving the hydraulic design of the structu of the whole installation. (Moore-IVI)
W84-01074

WHAT YOU SHOULD KNOW ABOUT FL METERS,
Sparling Instruments Co., Inc., El Monte,
C. W. Dean.
Water Engineering and Management, Vol. No. 6, p 38-40, June, 1983. 2 Fig.

Descriptors: *Flowmeters, Measuring instrum Gages, Wastewater facilities, Water treat facilities.

While flow meter technology has advanced gr in recent years, there are limitations of each d which should be known to the user. Ventur other differential producing flow meters op according to Bernoulli's Theorem. The accu of the primary device is good, over a reaso range. However, it is inferential and produc differential pressure and does not measure vel directly. The secondary devices used to inte the differential pressure as velocity cause accu degradation limiting the rangeability. These vices are sensitive to flow profile as anyt which changes upstream velocity distributio downstream vena contracta causes signif errors. Partial or total plugging of pressure creates substantial errors and maintenance p lems. In propeller meters the minimum flow r is limited by the starting friction of the mecha Maximum flow ranges are limited to such rota al speeds that permit long life. Propeller meter good flow profile averagers due to the large centage of the cross-sectional area of the co intercepted by the propeller. Transmissive u sonic flow meters use difference frequency t nology. Flow profile conditions in which a dis portionate amount of the liquid passes around pressure pulse path between the two transce will cause low readings. Doppler Ultrasonic meters are strongly dependent on velocity pr and the liquid must have particles in suspensio order to operate. (Baker-IVI)
W84-01327

l Mechanics

LISTIC UPDATING OF PORE PRES-LDS,
etts Inst. of Tech., Cambridge.
h, and E. H. Vanmarcke.
Geotechnical Engineering, Vol. 109, 373-387, March, 1983. 9 Fig, 3 Tab, 16 grant PFR-7815898.

s: *Pore pressure, *Earthworks, *Seep-matical models, Earth dams, Dam sta-

rmance of many earth structures is onditioned by pore pressure. A first-nd-moment method is proposed to quan-ainty about steady-state pore pressures in random spatial variability of soil ies. A Bayesian framework for system-etation of piezometer observations is set allows updating of the pore pressure therefore, of geotechnical performance . A probabilistic quantification of the al method is attempted, so that prob-igned to different hypotheses (states of arding seepage can also be updated on piezometer readings. Application of the o the decision problem of sequential location is suggested. The model was a typical cross-section of a hypothetical (Moore-IVI)

JGAL MODELING OF SOIL LIQUE-SUSCEPTIBILITY,
Univ., Davis. Dept. of Civil Engineer-
ndan, A. Anandarajah, and A. Abghari.
Geotechnical Engineering, Vol. 109, 1-300, March, 1983. 17 Fig, 4 Tab, 23

: *Earthquakes, *Pore pressure, *Soil , *Shear, Soil mechanics, Model stud-atical models, Sand, Soil water.

model tests were conducted on a sand confined by a stack of teflon ninum rings with a latex membrane sand and the rings. Dynamic centrifu-esting was performed in a 1 m radius entrifuge using a piezoelectric shaker. of Monterey 0 grade sand contained a apparatus modelled a sand layer. The was instrumented with pore pressure at different depths and accelerometers and top. The model was excited at the nusoidal motions of various amplitudes cess pore water pressures and the ace accelerations were monitored. The jectives were to study the generation on of excess pore water pressures, and the threshold peak ground surface ac-nd the threshold shear strain necessary ation of excess pore water pressure. e of prior strain history on the genera-water pressure was an additional ob-is study. The measured time history of pressure generation and pore water tribution with depth compared favor-at predicted by the currently available rocedures using dynamic test results small elements of homogeneous sand. ance was shown of the initial prior y on pore pressure development and y of the peak threshold acceleration rain estimated from dynamic tests on nts of homogeneous sand in cyclic tri-Moore-IVI)

GAL MODELING OF TRANSIENT OW,
neer Waterways Experiment Station, MS.
ll, and H.-Y. Ko.
Geotechnical Engineering, Vol. 109, 6-555, April, 1983. 11 Fig, 5 Tab, 15

Descriptors: *Model studies, *Earthworks, *Embankments, *Flow, Pore pressure, Drawdown, Headwaters, Transient flow, Flow rates.

The phenomenon of transient water flow in earth embankments is examined. State-of-the-art solution techniques and their shortcomings are outlined. It is hypothesized that better solutions are obtainable through centrifugal modeling of the process. An experimental program is described. In order to interpret the experimental results, theoretical scaling relations for quantities pertinent to transient water flow are developed through consideration of the basic independent variables governing the flow. Testing was conducted on a geotechnical centrifuge in a container specially constructed for the test series. Acceleration levels of 25 g, 37.5 g, and 50 g were used. Pore pressures were measured and recorded during the transient rise and fall of the headwaters by four miniature pressure transducers. From these data, histories of total head as a function of time and equipotentials during headwater rise and drawdown are plotted. Steady state flow rates are also measured. Analysis of the data leads to the conclusion that theoretical scaling relations are valid and that this method does indeed give a better understanding of the phenomenon of transient flow and may be useful in design practice. (Author's abstract)
W84-01084

LIQUEFACTION SITES, IMPERIAL VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, CA.
T. L. Youd, and M. J. Bennett.
Journal of Geotechnical Engineering, Vol. 109, No. 3, p 440-457, 13 Fig, 1 Tab, 16 Ref.

Descriptors: *Liquefaction, *Earthquakes, *Sand, Soil types, Sediments, Sand boils, Channels, Earthquake engineering, Soil physical properties, California, Imperial Valley.

Sands that did and did not liquefy at two sites during the 1979 Imperial Valley, California, earthquake (magnitude 6.6) are identified and their properties evaluated. From cone soundings, stratigraphy was determined, soil types and properties estimated, and optimal locations for samples and standard penetration tests (SPT) selected. Samples were used to classify sediments and to identify modes of deposition. SPT tests were used to evaluate liquefaction susceptibility. Loose fine sands in an abandoned channel liquefied and produced sand boils, ground fissures, and a lateral spread at the Heber Road site. Evidence of liquefaction was not observed over moderately dense over-bank sand east of the channel nor over dense point-bar sand to the west. Standard analyses predict that both the channel and the over-bank sands are liquefiable, but that the point bar is resistant. At the River Park site, a layer of loose floodplain silty sand overlies a layer of clay, which in turn overlies a thick bed of sand that increases in density with depth. Parts of both the upper silty sand and lower sand liquefied and produced hundreds of sand boils. Standard analyses predict that the looser parts of both layers are liquefiable. (Moore-IVI)
W84-01098

8F. Concrete

ZONE OF TENSILE STRESSES IN THE FOUNDATION OF A CONCRETE DAM (FROM OBSERVATION DATA),
V. N. Durcheva.
Hydrotechnical Construction, Vol. 16, No. 9, p 487-492, September, 1982. 2 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 32-35, September, 1982.

Descriptors: *Concrete dams, *Dam foundations, *Tensile strength, Gravity dams, Dam construction, Buttress dams, Seepage, Drainage, *USSR.

The occurrence of a zone of tension under the upstream face from operating loads is possible mainly in high gravity dams of a compressed profile constructed on a rigid foundation. Predicted decompression was confirmed by observation data for the Bratsk and Ust'-Ilim dams. The actual boundaries of the zone of decompression differ from those calculated, due to the effects of numerous technological factors during construction of the dams, which created additional compression or tension in the contact zone. One cause of the increase in the actual zone of decompression, compared to the calculated values, in the sections of the Bratsk dam was the incomplete solidity of the profile when filling of the reservoir began. At the Ust'-Ilim dam, maximum boundaries of decompression higher than those calculated were recorded in the powerhouse sections that absorbed the rise of the upper pool level of an offset profile. In buttress dams, according to the calculations, a zone of decompression should occur. Disturbance of the continuity in the contact plane was not recorded at the Andizhan dam at the normal pool level; at the Kirovskoe dam, under incomplete hydrostatic load, opening of the contact joint occurred, as a consequence of disturbance of the solidity of the contact concrete due to cracking. Compression of the upstream face and contact plane in dams sectioned into columns or elements can reduce the zone of biaxial tension. A reduction in the seepage pressure may lessen the unfavorable consequences of a decompressed foundation. In poorly permeable rocks, draining the foundation can considerably reduce uplift. (Moore-IVI)
W84-01067

CONSIDERATION OF THE UPLIFT PRESSURE OF WATER IN CALCULATIONS OF THE STABILITY OF CONCRETE DAMS ON ROCK FOUNDATIONS,
For primary bibliographic entry see Field 8A.
W84-01069

8G. Materials

INFLUENCE OF SUBSTRATUM WETTABILITY ON ATTACHMENT OF FRESHWATER BACTERIA TO SOLID SURFACES,
Warwick Univ., Coventry (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W84-01053

CARBONATE DEPOSITS IN VACUUM PUMPS OF O'NEILL PUMPING PLANT, CALIFORNIA,
Water and Power Resources Service, Sacramento, CA.
For primary bibliographic entry see Field 3C.
W84-01059

A CELL TO STUDY CORROSION OF MATERIALS IN THE WATER SUPPLY INDUSTRY,
Surrey Univ., Guildford (England). Dept. of Metallurgy and Materials Technology.
R. Walker, and R. J. Oliphant.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 2, p 143-150, April, 1983. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Corrosion, *Water conveyance, Galvanic cell, Solder, Lead, Tin, Copper, Pipes, Contamination, Corrosion control, Hydrogen ion concentration.

A galvanic cell was developed to study the corrosion that occurs when two metals or alloys are joined together and immersed in an electrolyte. The current that flows through the external circuit is used to calculate the rate or intensity of corrosion in static or flowing solutions. Data obtained in a study of solder show that the galvanic corrosion current for lead connected to a copper cathode is much higher than when tin is used. The value for a lead-tin solder anode is intermediate. The effect of the pH of the solution can also be determined and results show that for solder the galvanic current decreases as pH increases. Polarization diagrams can be used to indicate the maximum corrosion current density. Thus, the use of corrosion inhibitors to affect the rate controlling step can then be investigated with this cell. Sodium sulfate appears to act as an anodic corrosion inhibitor because it

affects the anodic curves and decreases the corrosion current from about 15 to 2 microA. The cell is useful in predicting the corrosion that may arise with different combinations of metals and alloys as well as various water conditions. (McKeon-IVI)
W84-01072

RECENT INVESTIGATIONS OF THE EPOXY RESIN LINING OF WATER MAINS,
WRC Engineering, Swindon (England).
R. W. Parkinson, I. C. Warren, and K. J. North.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 3, p 257-271, June, 1983. 7 Fig, 4 Tab, 16 Ref.

Descriptors: *Epoxy resins, *Water mains, *Linings, Microorganisms, Water conveyance.

The transition from laboratory-based trials to full-scale field applications of epoxy resin linings has highlighted problems with the consistent achievement of smooth, pinhole-free linings and the enhancement of non-pathogenic microbial activity in supply. Advancements in both equipment and materials have improved the quality of linings. However, further progress is required consistently to achieve the recommended 1 mm lining thickness. Changes to the epoxy resin formulations have resulted in materials which perform exceptionally well in the National Water Council (NWC) Approvals Scheme. The effect of these changes in supply has not resulted in the eradication of microbial activity, but a reduction in its duration. Recent investigations suggest that the increases are caused by system disruption during renovation and not the lining materials themselves. Work is in progress to assess the durability of these materials and to develop a comprehensive operational guideline manual which will provide the necessary information for the successful implementation of renovation programs using the epoxy resin lining process. (Author's abstract)
W84-01078

ENSURING WATER QUALITY IN A DISTRIBUTION SYSTEM,
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For primary bibliographic entry see Field 5F.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 17, NUMBER 5
MAY 1984

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 5
MAY 1984

W84-01401 -- W84-01769

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

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SELECTED WATER RESOURCES ABSTRACTS

VATER CYCLE

General

TORS AFFECTING THE ACCURACY OF NTITATIVE ANALYSES OF PRIORITY LUTANTS USING GC/MS,
odyne Engineers, Inc., St. Louis, MO.
Kirchmer, M. C. Winter, and B. A. Kelly.
ronmental Science and Technology, Vol. 17, . p 396-401. July, 1983. 3 Fig, 4 Tab, 12 Ref.

riptors: *Pollutants, *Gas chromatography, s spectrometry, Chemical analysis, ewater analysis, Calibrations.

obtained during the routine analyses of waters by GC/MS using EPA Methods 624 25 were statistically evaluated to determine rincipal sources of error in analysis. Random was found to be the principal cause of inac- y in analyses using Method 624. Bias in cali- n was found to be the principal source of in analyses using Method 625. Average rela- esponse factors were used to recalculate re- for Method 624, and while the predicted vement in accuracy was obtained in only one ce, further investigation is recommended. s were also recalculated for Method 625 by surrogate standards as internal standards to the calibration and sample analyses were the same way. The alternative calibration dure reduced calibration bias and random n comparison with the standard Method 625 dure. The advantages of using a calibration dure identical with sample analyses are dis- Suggestions are given for validating alter- methods prior to routine use. (Author's ab-

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ANNUAL PATTERN AND SPATIAL DIS- UTION OF AQUATIC OXYGEN METAB- M IN BOREAL FOREST WATERSHEDS,
s Hole Oceanographic Institution, MA.
Saiman.
gical Monographs, Vol. 53, No. 1, p 73-94, 3 Fig, 10 Tab, 40 Ref.

ptors: *Oxygen metabolism, *Forest water- *Aquatic ecosystems, Periphyton, Mosses, phytes, Organic matter, Primary productiv- etabolism, Streams, rivers, Lakes, Phyto- on, Spatial distribution, Channel morphol- uebec.

vel and diversity of metabolism in lotic ems are largely functions of channel geo- ology and hydrology, making site-specific difficult to extrapolate to other parts of the ed. This paper describes the pattern and ition of aquatic oxygen metabolism for un- ted boreal forest watersheds in eastern , Canada. Metabolism by periphyton, macrophytes, fine particle organic matter M: 0.5 micrometer-1mm), and coarse particu- ganic matter (CPOM: > 1mm) was exam- ring the ice-free period (April to Novem- 1979 and 1980 in First Choice Creek (first 207 sq km), Matemek River (sixth order; 673 and the Moisie River (ninth order; 19,871 As watershed area increases, primary pro- and the number of autotrophic groups are ted with moss and macrophyte communi- otal O2 metabolism increases downstream, from < 1 g/sq m/d in First Choice Creek ly 5 g/sq m/d during summer in the Moisie utotrophic metabolism is not normally cor- with light or chlorophyll, but annual O2 tion is highly correlated with stream order .76 in most cases). These data are com- with a geomorphological analysis of the ed to discern the spatial distribution of metabolism, and to estimate total aquatic ism in the Moisie River drainage network. occurring only in streams of fourth or order, are the most productive autotrophic ent in the watershed (3.9 x 10 to the 10th g/yr); by comparison, periphyton produce x 10 to the 10th power g/yr. FPOM is the most active detrital component (6.6 x 10 to the 10th power g/yr). Geomorphic analyses show that streams of fourth or higher order compromise only 1.2% of the total number and 12.7% of the total length, but have 76.8% of the lotic surface area, and are responsible for 86.3% of the gross production by the entire lotic drainage network. The surface area of lakes is approximately six times that of streams, but their contribution (phytoplankton) to total aquatic ecosystems metabolism is comparable only to that of lotic periphyton. Results demonstrate that the River Continuum Concept can be extended to the watershed level by combining biological measurements with geomorphological analyses of the drainage network, thus allowing a detailed description of spatial and temporal patterns for specific metabolic components and total ecosystem metabolism to be constructed. (Author's abstract)
W84-01645

AN EPHEMERAL STREAM-AQUIFER INTERACTION MODEL,
Adelaide Univ. (Australia). Dept. of Civil Engineering.
P. J. Dillon, and J. A. Liggett.
Water Resources Research. Vol. 19. No. 3 p 621-626, June, 1983. 13 Fig, 13 Ref. NSF grant CEE-7902803.

Descriptors: *Ephemeral streams, *Aquifers, *Hydraulic models, Streambeds, Groundwater movement, Water level fluctuations, Mathematical models, Green-Ampt equation, Boundary conditions, Boundary integral equation, Stream discharge, Australia, Little Para River.

The boundary integral equation method is applied to the interaction between an ephemeral stream and an unconfined aquifer through a semipervious streambed. The resulting two-dimensional vertical slice model describes groundwater flow when the stream and aquifer are hydraulically disconnected or connected as well as the transition between these two states. It incorporates the Green-Ampt equation with the hydraulically disconnected boundary conditions. The model was successfully calibrated using stream discharge and bore hydrograph data from the Little Para River recharge study, South Australia. It predicts with sufficient accuracy the inflow and outflow from the stream to the aquifer during fluctuating water levels in the stream. (Author's abstract)
W84-01704

DYNAMIC ADVECTIVE WATER QUALITY MODEL FOR RIVERS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-01767

2B. Precipitation

HIMALAYAN WINTER SNOW COVER AREA AND SUMMER MONSOON RAINFALL OVER INDIA,
Howard Univ., Washington, DC. Dept. of Geology and Geography.
B. Dey, and O. S. R. U. Bhandu Kumar.
Journal of Geophysical Research, Vol. 88, No. C9, p 5471-5474, June 20, 1983. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Snow cover, *Monsoons, *Rainfall, Satellite imagery, Correlation analysis, Himalayas, India.

The study presented in this paper examines the relationship between satellite-derived Himalayan snow cover extent in the winter season (December to March) and the amount of summer monsoon rainfall for the period 1971 to 1980. Himalayan snow cover area has been derived from satellite images and northern hemisphere snow cover charts produced by the National Oceanic and Atmospheric Administration National Environmental Satellite Service. Indian summer monsoon rainfall was the area-weighted mean of all meteorological subdivisions of India for the months June through September. The variations of Indian summer monsoon rainfall were compared with the variation of the Himalayan winter snow cover area. There is an inverse relationship (negative correlation) between these two variables, which indicated that more than mean Himalayan winter snow cover area is to be followed by less than normal (India Meteorological Department (IMD)) summer monsoon rainfall over India. The inverse relationships hold true for 8 out of 10 years of the study period. The coefficients of the correlation between the Himalayan snow cover area departures from the 10-year mean and the rainfall departures from IMD normals for all the meteorological subdivisions of India were computed. The negative correlations were found to be maximum in the region between 18 degrees N latitude and the foothills of the Himalayas. (Author's abstract)
W84-01490

2C. Snow, Ice, and Frost

ICE BREAKUP AND JAMMING OBSERVATIONS ALONG THE MACKENZIE RIVER,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
J. W. Kamphuis, and J. R. Moir.
Canadian Journal of Civil Engineering, Vol. 10, No. 1, p. 78-91, March, 1983. 14 Fig, 1 Tab, 2 Ref.

Descriptors: *Ice breakup, Ice jams, Melting, Mackenzie River, Canada.

The breakup of ice along the Mackenzie River between Fort Simpson and Fort Good Hope was studied in 1979, 1980, 1981, and 1982. This paper describes the 1980 and 1981 observations. An aircraft dedicated to this task was used to make over 40 observation flights during those two breakup seasons in which more than 20 major ice jams were observed during their formation, stationary position, and breakup. Although the paper is based on experience gained during only 4 years, it was found that all observed jams displayed the same major characteristics; hence it appears that general descriptions of ice melting, breakup, and jamming for the section of the Mackenzie River under investigation are possible. Although there could be additional variations, these are expected to be minor. The paper describes the ice melting process prior to any ice movement. The ice jamming process as it takes place along the Mackenzie River is discussed as well as the various parameters that affect this process. Several secondary factors that influence the detailed character of the jams are also addressed. (Author's abstract)
W84-01509

2D. Evaporation and Transpiration

ESTIMATION OF STREAMFLOW LOSS BY EVAPOTRANSPIRATION FROM A RIPARIAN ZONE,
Vrije Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
E. Seyhan, A. S. Hope, and R. E. Schulze.
South African Journal of Science, Vol. 19, No. 3, p 88-90, March, 1983. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Riparian water loss, *Evapotranspiration, Streamflow, Factor analysis, Correlation analysis, Regression analysis, Diurnal variation, Recession hydrograph, South Africa.

Recession hydrographs from a small research catchment in Zululand (South Africa) exhibited diurnal fluctuations in streamflow which were superimposed on the general recession trend. The daily additional reduction in flow was assumed to be the result of greater evapotranspirational losses in the riparian zone during the day. This reduction in flow was calculated for 76 days and an attempt was made to relate these values to hydrometeorological variables which could be expected to correlate with evapotranspirational losses. Factor analysis, correlation analysis and regression analysis were used to develop equations to estimate the daily additional reduction in streamflow. These equations were found to be satifactory with hydro-

graph stage being the most important independent variable. (Author's abstract)
W84-01443

EVAPOTRANSPIRATION OF EICHHORNIA CRASSIPES (MART.) SOLMS AND LEMNA MINOR L. IN CENTRAL FLORIDA: RELATION TO CANOPY STRUCTURE AND SEASON,
Florida Univ., Gainesville.
T. A. DeBusk, J. H. Ryther, and L. D. Williams.
Aquatic Botany, Vol. 16, No. 1, p 31-39, May, 1983. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Water hyacinth, *Evapotranspiration, Canopy, Seasonal variation, Temperature, Solar radiation, Duckweed, Evaporation, Water loss.

A major concern regarding water hyacinth (Eichhornia crassipes) infestations is the increased loss of water through evapotranspiration. However literature estimates of the evapotranspiration to open water evaporation ratio for Eichhornia may vary widely, from 1.4 to 3.7. Evapotranspiration of the freshwater macrophytes E. crassipes and Lemna minor was examined in tank cultures in Ft. Pierce, Florida. L. minor is a plant which grows essentially in two dimensions with little canopy variation. Evapotranspiration of both species during the year 1979 was significantly correlated with open water evaporation, solar radiation and mean temperature. Evapotranspiration of Eichhornia fluctuated by ca. 40% when its canopy structure was varied by manipulating plant stocking density or nutrient availability. Similar variations in canopy structure which commonly occur in natural stands of Eichhornia limit the value of evapotranspiration estimates made over a wide temporal or areal basis. Eichhornia is a floating plant adapted to riverine systems where expansions or reductions in habitat frequently occur, so the species rapidly responds to changing environmental parameters by varying its canopy structure and standing crop. (Moore-IVI)
W84-01453

EFFECT OF TRANSIENT, PARTIAL-AREA SHADING ON EVAPORATION FROM A BARE SOIL,
Kyushu Univ., Fukuoka (Japan). Irrigation Engineering Lab.
Y. Nakano, T. Cho, and D. Hillel.
Soil Science, Vol. 135, No. 5, p 282-295, May, 1983. 11 Fig, 11 Ref.

Descriptors: *Evaporation, *Soil surface, *Shade, Mathematical models, Simulation, Canopy, Water transport, Energy, Soil temperature, Soil water.

To evaluate the consumptive use efficiency of irrigated water, it is of interest to estimate the soil surface evaporation component of what is generally described by the term evapotranspiration. Interception of radiation by foliage is one of the major factors influencing evaporation. A three-dimensional mechanistic model describing soil-atmosphere energy exchange and water transport was developed in an effort to account for the effect of time-varying and space-variable shading on evaporation from a bare soil. A simple model of an inert (nontranspiring) plant was used to demonstrate the effect of shading on evaporation from the soil surface. The plant was represented hypothetically as an opaque, nonreflective sphere with the properties of a black-body emitter. During the course of a day, the effect of a canopylike shading body was to create a west-to-east shaded band in which soil surface temperature and evaporation were reduced (in comparison with a continuously sunlit surface) and soil moisture was enhanced. (Moore-IVI)
W84-01600

REPETITIVE-LOAD BEHAVIOR OF UNSATURATED SOILS,
E. S. Motan, and T. B. Edil.
Transportation Research Record, Vol. 872, p 41-48, 1982. 17 Fig, 1 Tab, 17 Ref.

Descriptors: *Soil mechanics, *Soil saturation, *Soil water suction, Sand, Clay, Plasticity, Matrix suction, Soil water, Soil compaction.

The resilient and residual deformation behavior of a number of soil samples under unconfined repetitive loading was investigated in the unsaturated state as a function of matrix suction. Matrix suction values within the range of 50-1500 kPa were achieved by using pressure-plate extractors. Results obtained during the first phase of the study on low-plasticity sand and clay mixtures are extended to high-plasticity clay during the second phase after a series of repetitive-load tests on statically compacted samples of grundite at both dry- and wet-of-optimum compaction moisture content. The resilient modulus is shown to be related to the matrix suction in a rather unique form for all soils tested; the maximum is at 800 kPa suction and it decreases thereafter and subsequently increases again significantly at very high suction values (as in the air-dried or oven-dried state). This maximum resilient modulus obtained at 800-kPa suction increases with decreasing plasticity index. The position and the form of the curve of resilient modulus versus matrix suction may undergo changes if deviator stress and confining pressure are introduced as variables. It is also shown that the resilient behavior of cohesive soils does not follow the same pattern as the relationship of unconfined strength versus suction beyond a suction value of 800 kPa. Furthermore, the postrepetetive testing unconfined strength of dry- and wet-of-optimum compacted samples seems to be better correlated with the moisture content than with the soil suction value. (Author's abstract)
W84-01755

2E. Streamflow and Runoff

FLOW TRANSFORMATIONS IN SEDIMENT GRAVITY FLOWS,
California Univ., Santa Barbara. Dept. of Geological Sciences.
R. V. Fisher.
Geology, Vol. 11, No. 5, p 273-274, May, 1983. 1 Fig, 26 Ref.

*Flow characteristics, *Gravity flow, *Sediment transport, Flow measurement, Streamflow, Runoff, Turbulent flow, Laminar flow.

Sediment gravity flows (subaerial or subaqueous) exhibit flow transformations, defined as changes in flow behavior between laminar and turbulent states. Laminar-turbulent transformations are influenced chiefly by particle concentration, thickness of the flow, and flow velocity (slope). At least four kinds of flow transformations can be identified: body transformations, gravity transformations, surface transformations, and fluidization transformations. Slumps or debris flows may change to turbidity currents with no change in water content when velocity is great enough to produce internal turbulence. The way that particles are supported within a flow in its final stages of movement largely determines the textures and structures within a bed. The manner of support is a direct function of particle concentration and amount of fine-grained cohesive sediment mixed with pore fluid, which in turn greatly affects whether or not laminar to turbulent or turbulent to laminar transformations take place. The concept of flow transformations is qualitatively useful in visualizing flow dynamics leading to the sequential development of beds within single depositional units. (Baker-IVI)
W84-01445

REGIONALIZED FLOW DURATION FOR PHILIPPINES,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. G. Quimpo, A. A. Alejandrino, and T. A. McNally.
Journal of Water Resources Planning and Management, Vol. 109, No. 4, p 320-330, October, 1983. 5 Fig, 2 Tab, 8 Ref. INT7907044.

Descriptors: *Available water, *Flow duration, Mapping, Regression analysis, Small hydropower sites, Phillipines.

A regionalization technique is employed to estimates of water availability at ungaged p small hydropower sites in the Philippine flow duration characteristics at representa cations across the country were first parame to permit numerical interpolation. Then t graphic variation of one of the paramete mapped to span the whole archipelago. U gression, another parameter was expresse function of the drainage area. The regio map and the regression equation may then to synthesize a flow duration curve at an u site. Future modifications of the proced suggested as additional data become av (Author's abstract)
W84-01468

EFFECTS OF SOIL PROPERTIES ON O LAND FLOW AND INFILTRATION,
Illinois Univ. at Urbana-Champaign. Dept. o Engineering.
B. C. Yen, and A. O. Akan.
Journal of Hydraulic Research, Vol. 21, N 153-172, 1983. 21 Fig, 1 Tab, 21 Ref.

Descriptors: *Overland flow, *Soil prop Mathematical models, Simulation, Soil po Permeability coefficient, Saturated flow, U rated flow, Soil water suction, Infiltration, P size.

Soil properties have profound effects on ov flows over porous media. These effects are i gated by using a surface-subsurface flow co tive simulation model which solves the Venant equations for the overland flow and ards' equation for the two-dimensional unsat and saturated porous medium flow. Guided dimensional analysis, four soil properties are ied, namely, porosity, vertical and horizontal rated hydraulic conductivities, and unsaturat hydraulic characteristics which are express two pairs of parameters describing the rel ships between the degree of saturation and s pressure, and between the relative conduc and suction pressure, respectively. The results firm the common belief that overland flo creases for decreasing soil porosity or satu conductivity while the infiltration into the decreases. The effect of the ratio between ho tal and vertical saturated conductivity is insi cant, indicating the soil anisotropic effect is portant. Moreover, the overland flow dec and infiltration increases for soils having suction pressure head in the saturation and re conductivity vs. suction pressure relations corresponding, to, e.g. increasing soil particle than for soils having large suction pressure (Author's abstract)
W84-01484

STOCHASTIC ANALYSIS OF HIGH FLOW SOME CENTRAL BRITISH COLUM RIVERS,
Saskatchewan Univ., Saskatoon. Dept. of Geo phy.
P. R. Waylen, and M.-K. Woo.
Canadian Journal of Civil Engineering, Vol No. 2, p 205-213, June, 1983. 7 Fig, 2 Tab, 14

Descriptors: *High flow, *River flow, Probab distribution, Frequency distribution, Flow d tion, Flow magnitude, Model studies, Stoch studies, Floods, British Columbia.

High flows derived from the partial duration s were analysed in terms of the probability distr tions of magnitude, frequency, durations, and time of occurrence. Simple methods of repres ing the timing and duration of high flows as chastic variables are presented. Existing stocha models are applied to the probability distribut of the annual frequency of high flows and magnitudes. A consideration of the statistical p erties of the above stochastic variables leads to development of a technique with which flo exceeding any higher level of interest may investigated without resorting to a reanalysis of historical data. The proposed methodology applied to the daily streamflow records of th

located in diverse hydrological environ-
in Central British Columbia. Good agree-
etween the computed and the observed data
cases reflected the applicability of the tech-
(Author's abstract)
1511

N HEADWATER FLOODING DAMAGE
NTIAL,
s (J.H.) Co., Redondo Beach, CA.
ee, and T. L. Essex.
l of Hydraulic Engineering, Vol. 109, No. 4,
35, April, 1983. 2 Fig, 7 Tab, 12 Ref. ENV-
58.

ptors: *Headwater flooding, *Urban areas,
drainage, Flood damage, Flooding, Head-

ater flooding, flooding from a small drain-
a affecting only a few structures, has gener-
en ignored in estimating national flood
A field survey of 15 small, completely or
y urbanized watersheds encompassed about
structures and identified 241 structures sub-
tributary flooding, 28 structures subject to
tion flooding, 100 subject to ponding, and
ject to constricted flow. A technique is
ed for estimation the losses from headwa-
ding, with an estimate of $324 million per
977) obtained. (Moore-IVI)
534

ICAL METHOD OF ESTIMATING
FLOW,
l Hydrology Research Inst., Ottawa (On-

ngal.
of Hydraulic Engineering, Vol. 109, No. 4,
63, April, 1983. 5 Fig, 10 Tab, 6 Ref.

tors: *Flood peak, *Floods, Rainfall, Math-
l studies, Streamflow, Hydrographs, Ontar-

riables used are the mean daily flows of
onsecutive days with the maximum mean
ow occupying the middle position. A pa-
designated as base factor K, has a govern-
ence on the estimated peak. Its value lies
zero and two. The predicting formula
this study assumes the K value equal to
e method was applied to streams in Ontar-
tal of 387 stations equipped with recording
ere used. The drainage areas of the basins
om less than 1 sq km to more than 100,000
The number of instantaneous peak data
e was 3,946 in the period of record ending
out 57% of the predicted peaks lie within
0%, and 79% lie within + or - 20% of the
alues. About 62% of the peaks were over-
d. The parameter K must be estimated for
loods occurring on small streams. Its value
erally be less than one for such cases. As K
ts the base of a triangular hydrograph, its
an be estimated from any method of a
zing graph. When peak data are available,
f K can be computed; these values may be
ed to nearby streams of similar physical
ristics. (Moore-IVI)
35

G PROCEDURES FOR THE LOG-
TON DISTRIBUTION,
Univ., Nathan (Australia). School of Aus-
nvironmental Studies.
oughton, and E. D. Shirley.
of Hydraulic Engineering, Vol. 109, No. 4,
9, April, 1983. 2 Fig, 4 Tab, 6 Ref.

ors: *Annual floods, *Flood frequency,
ers, Walnut Gulch, Santa Cruz River, Ari-

inal description of the log-Boughton dis-
for frequency analyses of annual floods
trial-and-error procedures for fitting the
on to a set of data. A procedure is de-
for direct, optimal fitting of the log-
n frequency distribution to either com-
plete sets or subsets of annual flood data. The analytical basis and derivation of the procedure are given. Annual floods from 65 yr of record on the 5,755-sq km Santa Cruz River at Tucson, Arizona, are used to show the fitting of the distribution to a complete data set, and annual floods from 24 yr of record on the 149-sq km Walnut Gulch watershed, in southeastern Arizona, are used to show the fitting of the distribution to a subset of data. Substantial differences between the log-Boughton and log-Pearson type 3 distributions occur in fitting to the Walnut Gulch data, due mainly to the large negative skew coefficient (-2.83) of this data set. The computer program which fits the log-Boughton distribution plots the data points on a probability paper which is automatically scaled to linearize the fitted distribution. Records with years of zero flow can be fitted directly without making arbitrary adjustments. (Moore-IVI)
W84-01537

ANALYTICAL DETERMINATION OF FORM FRICTION FACTOR,
George Washington Univ., Washington, DC. Dept. of Civil, Mechanical, and Environmental Engineering.
M. I. Haque, and K. Mahmood.
Journal of Hydraulic Engineering, Vol. 109, No. 4, p 590-610, April, 1983. 12 Fig, 1 Tab, 25 Ref. INT 76-84262.

Descriptors: *Friction, *Bedforms, Ripple marks, Dunes, Hydraulic roughness, Alluvial hydraulics, Steepness, Stream discharge, Streambeds.

The form friction factors for an idealized series of two-dimensional bedforms simulating a train of ripples or dunes in alluvial channels are obtained analytically by integrating the pressure along the bedform profiles. The roughness element is assumed to act independently so that the form friction factor can be obtained by analyzing the flow over a single bedform. The pressure distribution along the bedform is obtained by analyzing the incompressible, rotational inviscid flow over a theoretical ripple profile with the help of the Finite Element Method. A family of curves representing the relationship between form friction factor and relative depth with different bedform steepness ratios are numerically obtained. The comparison with the observed data shows a fair agreement. (Author's abstract)
W84-01538

DEVELOPMENT AND PREDICTION OF BED ARMORING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. W. Shen, and J. Y. Lu.
Journal of Hydraulic Engineering, Vol. 109, No. 4, p 611-629, April, 1983. 14 Fig, 5 Tab, 19 Ref. ENG-78250554.

Descriptors: *Bed armoring, *Particle size, Dam effects, Sediment transport, Turbulence, Hiding effect, Mathematical models.

After the construction of a dam, the clear water released from the reservoir usually causes the downstream river to degrade. One critical ingredient for the successful application of mathematical models to the degradation problem is how to predict change of bed material size distribution during the degradation process and the final composition of the armoring layer. Available data are used to predict the development of bed armoring and the final composition of grain size distribution. First, the different factors influencing the incipient motion for nonuniform sediment size distribution are examined. Then, the procedures for simulating the grain size distribution of the armor layer are developed based on modifications of Gessler's procedure and Einstein's hiding factor. The final armor coat can be simulated reasonably well based on Gessler's procedure if: the Shields curve is slightly modified; the hiding effect is introduced; and the turbulence level is considered. Three regression equations are derived to predict the median size of the final armor bed, given the initial sediment bed size distribution and flow conditions. A modified Shields diagram for incipient motion for nonuniform sediment sizes is also suggested. (Moore-IVI)
W84-01539

MODELING OF UNSTEADY-FLOW WATER TEMPERATURES,
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
M. H. Chaudhry, D. E. Cass, and J. E. Edinger.
Journal of Hydraulic Engineering, Vol. 109, No. 5, p 657-669, May, 1983. 8 Fig, 17 Ref.

Descriptors: *Water temperature, *Mathematical models, Simulation, River Flow, Lakes, Unsteady flow, Diversion, Columbia River, Kootenay River.

A mathematical model is presented to simulate water temperatures of one-dimensional unsteady flows in a river-lake system having time-varying lateral inflows and several cross-sectional changes along its length. In the hydraulic part initial steady state conditions are computed by numerically integrating the gradually-varied flow equation using the fourth-order Runge-Kutta method and the unsteady flow conditions by integrating the one-dimensional Saint Venant equations using an implicit finite difference method. An upwind implicit finite difference scheme is used to solve the partial differential equation governing the water temperature of unsteady flows. To verify the mathematical model, water temperature data on the Columbia and Kootenay Rivers measured during 1977 through 1979 were used. Overall, there was good agreement between the measured and computed water temperatures at almost all locations. There was also very good agreement between the shapes of the computed and measured traces. The model was used to predict the effects of the Kootenay River diversion on the temperature regime of the Columbia River. (Moore-IVI)
W84-01540

APPLICABILITY OF DAM-BREAK FLOOD WAVE MODELS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W84-01543

TURBULENT FLOW OVER UNDULAR PERMEABLE BOUNDARIES,
Exxon Research and Engineering Co., Florham Park, NJ.
R. T. Ho, and L. W. Gelhar.
Journal of Hydraulic Engineering, Vol. 109, No. 5, p 741-756, May, 1983. 9 Fig, 1 Tab, 23 Ref. GK31774X.

Descriptors: *Turbulent flow, *Boundary permeability, Pipe flow, Undulation, Boundary pressure, Velocity, Wave form, Wavy pipes.

The interaction between turbulent flow and compliant confining boundaries often generates wavy interfaces which eventually modify the flow characteristics significantly. This is a common phenomenon in many natural flows, including: the formation of various bedforms in alluvial channels; the generation of water waves by wind; the growth of ripples on the underside of river ice; and the production of sand dunes in deserts. The effects of boundary permeability and undulation in turbulent pipe flow are observed in an air flow conduit lined with a granular permeable material. Boundary pressure, mean velocity distribution, and longitudinal turbulence intensity were measured at several sections along the sinusoidal boundary. The observed boundary pressure shows a phase shift relative to the boundary wave form and a magnitude similar to that found from a simple potential flow analysis. The mean velocity distributions differ drastically from those observed in impervious wavy pipes, implying an important effect of the aspiration from the porous boundary in the lee of the wave form. The observations of turbulence intensity show that boundary permeability dramatically alters the turbulence structure as compared to an impervious wavy pipe. In the permeable pipe, a zone of high intensity turbulence develops in the

lee of the boundary wave form and expands to the central portion of the pipe. For impervious wavy pipes, the high turbulence intensity occurs only near the boundary as in the case of a straight pipe. (Moore-IVI)
W84-01545

SUSPENDED SEDIMENT EFFECT ON FLOW RESISTANCE,
National Water Research Inst., Burlington (Ontario). Environmental Hydraulics Section.
Y. L. Lau.
Journal of Hydraulic Engineering, Vol. 109, No. 5, p 757-763, May, 1983. 4 Fig, 13 Ref.

Descriptors: *Suspended sediments, *Velocity, Flow resistance, Mathematical models, Wake function, Boundary conditions.

A general velocity distribution consisting of a logarithmic profile plus a wake function has been used to investigate the effect of suspended sediment on flow resistance. From the experimental evidence that the wake constant increases when sediment is in suspension, it is shown that flow resistance must be reduced. It is shown that a flow with suspended sediments should have lower velocities near the boundary and higher velocities further away from the boundary than a clear water flow, given that the discharge and slope are identical. (Author's abstract)
W84-01546

IMPROVED FLOODPLAIN MANAGEMENT CAN BE COST-EFFECTIVE,
J. A. Biggs.
American City and County, Vol. 98, No. 4, p 43-44, April, 1983. 1 Fig.

Descriptors: *Flood control, *Flood plain management, Photography, Aerial photography, Passaic River, River basins, New Jersey.

An estimated annual flood damage figure of $48 million makes the Passaic River Basin the more serious flood zone in New Jersey. The Rockaway River, a stream within the basin, drains 95 sq mi before entering Denville Township. In the township virtually the entire riverfront is subject to flooding. Documentation of the January 25, 1979 flood provided a data base for future floodplain management activities. Aerial and ground level photographs, along with a rough log that showed the times they were taken, formed the basic data for analyzing the floodplain within the township. The photo records were then transformed to engineering-type data through a land survey. After the study was completed it was used by the township in several ways: it formed the basis for a formal objection to the state Department of Environmental Protection concerning that agency's preliminary revision of the 1975 HUD/FIA map; it is used continuously by the engineering department to evaluate the flooding potential of existing and proposed houses; it is used to make decisions involving floodplain property; it has been a basic reference tool whenever the township considers such project as road construction and the construction of senior citizens' housing, municipal buildings, museums, libraries and other buildings; and photographs from the study have been introduced as evidence in municipal court to prove the floodplain status of properties where illegal fill has been placed. (Baker-IVI)
W84-01666

PARAMETER ESTIMATION IN RAINFALL-RUNOFF MODELS,
Newcastle Univ. (Australia).
B. J. Williams, and W. W-G. Yeh.
Journal of Hydrology, Vol. 63, No. 3-4, p 373-393, June, 1983. 8 Fig, 8 Tab, 27 Ref. NSF grant CEE 81-13500.

Descriptors: *Rainfall-runoff relationships, *Error analysis, Mathematical models, Linear programming, Quadratic programming, Computer models.

In the practical application of rainfall-runoff models a number of catchment parameters are not directly measurable and it is desirable to make the best possible estimate from known rainfall-runoff data. Linear programming (LP) is used to minimize the sum of absolute errors (MSAE) of the computed hydrograph. Quadratic programming (QP) is used in the two other techniques, namely ordinary least squares (OLS) and generalized least squares (GLS). OLS uses the traditional regression objective of minimizing the square of the deviation while GLS uses a weighted form of the OLS objective which can eliminate the effect of serially correlated errors (noise). The techniques are demonstrated using a hypothetical catchment for which rainfall-runoff series are generated using a connceptual model. Four parameters necessary for the model's operation are then estimated, with varying levels of noise superimposed on the generated series, using the three techniques and then finally the techniques are applied to a real catchment. The computational efficiency and rate of convergence were demonstrated to be good. The proposed methodology is very general and it can be applied to any conceptual rainfall-runoff model. The GLS technique has proven superior to the traditional OLS technique and would appear to be preferable in practical estimations. (Moore-IVI)
W84-01699

WAVE SPEED-DISCHARGE RELATIONS IN NATURAL CHANNELS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
T. H. F. Wong, and E. M. Laurenson.
Water Resources Research, Vol. 19, No. 3, p 701-706, June, 1983. 8 Fig, 2 Tab, 9 Ref.

Descriptors: *Flood waves, *Velocity, Flood discharge, Mathematical studies, Flood routing, Runoff routing, Murrumbidgee River, Darling River, Mitta Mitta River, Australia.

An important parameter in flood routing is the speed at which the flood wave travels along the river reach. Empirical studies of wave speed for six reaches of the Murrumbidgee, Darling and Mitta Mitta rivers in Australia show that wave speed at first increases quickly with discharge, then decreases quickly, and finally increases slowly. The increasing parts of the relation can be fitted by power functions with exponents less than unity. Minimum wave speed occurs close to bank-full discharge. These results have a direct application to storage-discharge relations and important implications in flood routing and runoff routing. (Moore-IVI)
W84-01712

SIMULATION OF SOLUTE TRANSPORT IN A MOUNTAIN POOL-AND-RIFFLE STREAM: A TRANSIENT STORAGE MODEL,
Geological Survey, Menlo Park, CA.
K. E. Bencala, and R. A. Walters.
Water Resources Research, Vol. 19, No. 3, p 718-724, June, 1983. 8 Fig, 1 Tab, 25 Ref.

Descriptors: *Mountain streams, *Solute transport, Streams, Simulation, Mathematical models, Transient storage, Pools, Riffles, Convection, Dispersion, Chloride.

The physical characteristics of mountain streams differ from the uniform and conceptually well-defined open channels for which the analysis of solute transport has been oriented in the past and is now well understood. These physical conditions significantly influence solute transport behavior, as demonstrated by a transient storage model simulation of solute transport in a very small (0.0125 cu m/s) mountain pool-and-riffle stream. The application is to a carefully controlled and intensively monitored chloride injection experiment. The data from the experiment are not explained by the standard convection-dispersion mechanisms alone. A transient storage model, which couples dead zones with the one-dimensional convection-dispersion equation, simulates the general characteristics of the solute transport behavior and a set of simulation parameters were determined that yield an adequate fit to the data. However, considerable uncertainty remains in determining physically realistic values of these parameters. The values of the simulation parameters used are compared w used by other authors for other streams T parison supports, at least qualitatively, th mined parameter values. (Author's abstract W84-01714

A STOCHASTIC-DYNAMIC MODEL REAL TIME FLOOD FORECASTING,
Queen's Univ., Kingston (Ontario).
K. C. A. Chow, W. E. Watt, and D. G. Wa
Water Resources Research, Vol. 19, No. 3 752, June, 1983. 10 Fig, 3 Tab, 9 Ref.

Descriptors: *Flood forecasting, *Model *Stochastic process, Water level, Headpon New Brunswick, Saint John river, Ma Dam, Fredericton.

A stochastic-dynamic model for real tim forecasting was developed using Box-Jenki elling techniques. The purpose of the for system is to forecast flood levels of the Sa River at Fredericton, New Brunswick. Th consists of two submodels: an upstream mo to forecast the headpond level at the Ma Dam and a downstream model to forec water level at Fredericton. Inputs to the sy recorded values of the water level at East ceville, the headpond level and gate pos Mactaquac, and the water levels at Fred The model was calibrated for the spring fl 1973, 1974, 1977, and 1978, and its usefuln verified for the 1979 flood. The forecasting indicated that the stochastic-dynamic mo duces reasonably accurate forecasts for lea up to two days. These forecasts were the pared to those from the existing forecasting and were found to be as reliable as those fi existing system. (Author's abstract)
W84-01718

RUNOFF PREDICTION ERRORS AND IN PARAMETER ESTIMATION INDUC SPATIAL VARIABILITY OF PRECIPITA
Geological Survey, Menlo Park, CA.
B. M. Troutman.
Water Resources Research, Vol. 19, No. 3, 810, June, 1983. 12 Fig, 13 Tab, 27 Ref.

Descriptors: *Rainfall-runoff relationships, analysis, *Mathematical models, Precipitatio chastic methods, Spatial variability, Pre Rainfall distribution.

Spatial variability of precipitation causes i mean squared errors of prediction in precip runoff modeling. One component of these errors is a bias, which often takes the form o prediction for large events and underpredict small events. This problem is examined us assumed stochastic structure for the spatial ior of rainfall together with a form of the Ampt infiltration equation for prediction of runoff volume. The stochastic rainfall model porates the nonstationarity and spatial corr exhibited by actual rainfall. The bias in prediction causes parameter estimates obtai least squares calibration to be asympto biased. The magnitude and direction of th depends on the interaction between the prediction bias and the sensitivity of pre runoff to changes in parameter values. Nu climatic and hydrologic factors exercise an ence on this interaction. (Author's abstract)
W84-01722

BAYESIAN SURROGATE FOR REGI SKEW IN FLOOD FREQUENCY ANAL
Monash Univ., Clayton (Australia). Dept. o Engineering.
G. Kuczera.
Water Resources Research, Vol. 19, No. 3, 832, June, 1983. 7 Fig, 9 Tab, 27 Ref.

Descriptors: *Flood data, *Flood frequ *Temporal distribution, Design floods, Floo tribution, Frequency analysis.

oblem of how to best utilize site and region-
l data to infer the shape parameter of a
istribution is considered. One approach to
oblem is given in Bulletin 17B of the U.S.
Resources Council (1981) for the log-Pear-
ribution. Here a lesser known distribution is
red, namely, the power normal which fits
ata as well as the log-Pearson and has a
arameter denoted by lambda derived from
Cox power transformation. The problem of
lizing lambda is considered from an empiri-
es perspective where site and regional flood
e used to infer lambda. The distortive ef-
spatial correlation and heterogeneity of site
g variance of lambda are explicitly studied
atial correlation being found to be of sec-
importance. The end product of this analy-
e posterior distribution of the power normal
ers expressing, in probabilistic terms, what
m about the parameters given site flood
d regional information on lambda. This
ion can be used to provide the designer
veral types of information. The posterior
ion of the T-year flood is derived. The
f nonlinearity in lambda on inference is
ed. Because uncertainty in lambda is explic-
wed for, the understatement in confidence
ie to fixing lambda (analogous to fixing log
s avoided. Finally, it is shown how to
ne marginal flood distribution which can be
select a design flood with specified excee-
robability. (Author's abstract)
724

**CATION OF A BAYESIAN MODEL TO
T SHIFTS IN THE MEAN OF A SERIES
CATION D'UN MODELE BAYESIEN
CTECTION DE CHANGEMENTS DE
NNES DANS UNE SERIE),**
Quebec, Montreal. Service Hydraulique.
eau, and J.-C. Rassam.
gical Sciences Journal, Vol. 28, No. 3, p
September, 1983. 10 Fig, 5 Tab, 9 Ref.

ors: *Mathematical models, *Flow, *Res-
peration, Bayesian models, Climate, River
eans, Sainte-Anne du Nord River, Quebec.

ian model has been applied on the annual
nthly flow series of the Sainte-Anne du
ver in order to check the influence of the
n of four reservoirs on the monthly series
of a shift delta in the mean at time Tau.
ne model has been tested on two other
us permitting identification of those shifts
uld be attributed to regionally observed
variations. (Author's abstract)
61

**LOGICAL RESPONSE PATTERNS OF
THIRD ORDER STREAMS ON THE
ENT COMPLEX OF SOUTHWESTERN
A,**
(Nigeria). Dept. of Geography.
ejuwon, L. K. Jeje, and O. O. Ogunkoya.
gical Sciences Journal, Vol. 28, No. 3, p
September, 1983. 3 Fig, 3 Tab, 21 Ref.

ors: *Seasonal variation, *Hydrological
*Flow discharge, Peak discharge, Rainy
Dry season, River flow, Groundwater,
ty, Recession, Hydrological response,
Regolith depth, Nigeria.

drological response patterns of 15 third
ers in southwestern Nigeria are described
of regime, discharge variability and reces-
flow from peak discharge in the rainy
the lowest discharge in the dry season.
ximum and minimum discharges of the
oincide with the rainy and dry seasons
ely. Most of the rivers exhibit erratic flow
ck responses to storms and storm water
quickly, while some have a very low
ater contribution to streamflow, a phe-
which accounted for their drying up for
able periods in the year. The variability
f discharge of the rivers range from 0.25
while the recession constants range from
0.98. The variability indices are much
an those of basins of similar size reported from other studies. Three types of rivers are recognizable on the basis of their hydrological response patterns: rivers characterized by perennial flow, low variability of discharge, and gentle recession of flow from peak discharge in the rainy season to minimum discharge in the dry season; rivers with high discharges during the rainy season but which dry up completely for between 100 and 150 days in the dry season; and seasonal rivers which dry up for between 190 and 270 days in the year. The nature of the surficial and solid geology has a greater influence on discharge characteristics than other factors such as depth of regolith and rainfall. (Moore-IVI)
W84-01763

ON BACKWATER EFFECTS IN LINEAR DIFFUSION FLOOD ROUTING,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
J. C. I. Dooge, Z. W. Kundzewicz, and J. J. Napiorkowski.
Hydrological Sciences Journal, Vol. 28, No. 3, p 391-402, September, 1983. 2 Tab, 10 Ref.

Descriptors: *Flood routing, *Linear diffusion, *Boundary conditions, *Downstream, Mathematical models, Laplace transformation, Modal analysis.

The linear parabolic model of unsteady river flow (diffusion analogy) has the advantage of being a simple means of flood routing. The effect of the downstream boundary condition on the flow in a channel reach as predicted by the linear diffusion analogy model is analyzed by both Laplace transformation and by modal analysis. In each case the solution takes the form of an infinite series. The series based on Laplace transformation is highly convergent for small times and the series based on modal analysis is highly convergent for medium and longer times. (Moore-IVI)
W84-01764

2F. Groundwater

AQUIFER TESTS AND WELL FIELD PERFORMANCE, SCIOTO RIVER VALLEY, OHIO: PART I,
S. E. Norris.
Ground Water, Vol. 21, No. 3, p 287-292, May-June, 1983. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Aquifer characteristics, *Infiltration, Transmissivity, Streambeds, Pumping, Drawdown, Scioto River, Ohio.

Based on 13 aquifer infiltration tests at 11 sites, aquifer transmissivity ranged from 17,000 to 40,000 sq ft per day, and the streambed infiltration rate ranged from 0.06 to 0.19 million gallons per day per acre along a 7-mi reach of the Scioto River in south-central Ohio. Despite these wide ranges, the sand and gravel aquifer, 40 to 65 ft thick, underlying 10-20 ft of river alluvium south of the glacial boundary, is fairly homogeneous due largely to the absence of till interbeds. Performance of a major well field designed on the basis of the tests has been about as predicted, validating the techniques of data collection and analysis. At each site, a well for pumping was drilled on the floodplain, 150 to 175 ft from the river, and an array of observation wells was installed on lines extending through the pumped well, one line perpendicular to the river and the other parallel. Values of drawdown measured in the observation wells at the end of constant-rate pumping periods, usually of three days duration, were used to determine line-source distance and aquifer transmissivity. The rate of streambed infiltration and the streambed-leakage factor, the latter term relating the infiltration rate to drawdown beneath the stream, also were determined at all but one site. Drive-point wells installed in the riverbed, or along the near bank, in the vicinity of the pumped well were used to determine drawdown beneath the river due to pumping. (Author's abstract)
W84-01548

GROUND-WATER MODEL FOR A THICK FRESH-WATER LENS,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
C. C. K. Liu, L. S. Lau, and J. F. Mink.
Ground Water, Vol. 21, No. 3, p 293-300, May-June, 1983. 10 Fig, 2 Tab, 12 Ref.

Descriptors: *Groundwater, *Freshwater lens, Aquifers, Groundwater movement, Simulation, Pumping, Pumping, Mathematical models, Groundwater recharge, Pearl Harbor aquifer, Oahu, Hawaii.

The Pearl Harbor aquifer, an important groundwater resource for southern Oahu, Hawaii, contains an enormous fresh-water lens, up to 300 m (1,000 ft) thick, floating above saline water. The upper boundary of the fresh-water lens is confined near the coast and phreatic inland, whereas its lower boundary is not confined. A finite-difference flow model was used to simulate the Pearl Harbor aquifer system. The location of the fresh-water / salt-water interface, which constitutes the lower boundary of the flow system model, was estimated by Hubbert's formula. Known geohydrologic boundaries and aquifer parameters were also simulated. First, formation of the lens by filling the aquifer with fresh water from natural recharge was simulated to reconstruct the initial conditions before exploitation of the lens and to partially calibrate the model against the hydraulic-head distribution in 1879. The model then was calibrated fully by simulating the lens' response to actual historical pumping patterns covering a time span of 100 years (1880 to 1980). Simulated heads compared favorably with the observed heads over time and space. The calibrated flow model may serve as a useful tool in the management of the Pearl Harbor aquifer. (Author's abstract)
W84-01549

GROUND-WATER SYSTEMS SIMULATION BY TIME-SERIES TECHNIQUES,
Aspinwall Hydrotechnical Services Ltd., Shrewsbury (England).
J. F. T. Houston.
Ground Water, Vol. 21, No. 3, p 301-310, May-June, 1983. 10 Fig, 6 Tab, 9 Ref.

Descriptors: *Simulation, *Groundwater, Time-series, Hydrologic budget, Pumping rates, Geohydrology, Mathematical models, Rainfall, Mine dewatering, Groundwater management, Water level fluctuations.

The application of time-series techniques to groundwater problems is a logical extension of the water balance approach, allowing a water balance equation to become dynamic and thus simulating a groundwater system in time. The basic time-series techniques are considered in relation to hydrogeology and two case histories show their application to real systems. Water level fluctuations in a well field are shown to be dependent upon pumping rates and prior rainfall and can be simulated by a multiple linear regression model. The rate of dewatering of a mine is shown to be dependent upon pumping rates and prior rainfall and can be simulated by a multiple linear regression model. The rate of dewatering of a mine is shown to be dependent upon antecedent mine size and rainfall, and can also be simulated by a multiple linear regression model. Such models can be used for forecasting and control of the groundwater systems, and once formulated are ideally suited to the management of groundwater systems where more costly and complex methods cannot be used. (Moore-IVI)
W84-01550

PORE-WATER PRESSURE IN THE ROOF OF AN UNDERGROUND COAL MINE IN ILLINOIS,
Illinois State Geological Survey Div., Champaign.
K. Cartwright, C. S. Hunt, R. D. Brower, and W. J. Nelson.
Ground Water, Vol. 21, No. 3, p 311-316, May-June, 1983. 4 Fig, 11 Ref.

Descriptors: *Pore pressure, *Mine drainage, Coal mines, Permeability coefficient, Groundwater, Geohydrology, Water table, Stratigraphy.

Most underground coal mines in Illinois are relatively dry despite their location in saturated rock lying hundreds of meters below the water table. This is probably due to the low permeabilities of the rock units associated with the coal seams. Little is known about how mines affect the groundwater system, so it is difficult to predict where a mine is likely to encounter an influx of ground water. To obtain information on the hydrogeological character of the roof rocks, an array of piezometers was installed in roof-bolt holes at two locations within an underground coal mine in central Illinois. Pressure vs. time measurements were obtained from piezometer arrays located in areas of the mine ranging from dry to wet conditions. Data collected from the piezometers indicate that water drainage from a saturated sandstone above the coal is largely controlled by local structural and stratigraphic features, and these features determine the distribution of wet and dry areas in the mine. Hydraulic conductivities of the sandstone were determined in the laboratory and in situ from drainage profiles and from tests of instantaneous head changes. Results of these tests indicated that dewatering in front of mining would not be successful in this mine. (Author's abstract)
W84-01551

HYDROGEOLOGY OF THE LITTLEFIELD SPRINGS, ARIZONA,
Bureau of Reclamation, Boulder City, NV.
D. A. Trudeau, J. W. Hess, and R. L. Jacobson.
Ground Water, Vol. 21, No. 3, p 325-333, May-June, 1983. 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Groundwater recharge, *Geohydrology, *Springs, Tritium, Water quality, Littlefield Springs, Virgin River, Arizona.

A hydrogeologic investigation was conducted to determine the source of recharge to the Littlefield Springs, a series of carbonate springs occurring along a 10 km (6 mile) reach of the Virgin River in northwestern Arizona. The most probable sources of recharge to the springs were determined to be influent Virgin River water and precipitation within the springs by hydrologic basin. These recharge sources could account for the total discharge of the springs. The Littlefield Springs have essentially constant discharge 1.84 cms (65 cfs), and quality 2940 mg/L TDS. Tritium analyses of the spring and river water indicate that there are at least two different sources of recharge to the Littlefield Springs - one a minimum of 22 years old and the other younger than 22 years old. Analysis of the influent Virgin River upstream from the springs indicates a 1.42 cms (50 cfs) loss at 2130 mg/L TDS and the same ionic ratio of dissolved constituents as the springs. The travel time of this recharge source is interpreted to be a minimum of 22 years. Local recharge to the springs has been estimated to be 0.31 cms (11 cfs). The presence of local recharge is indicated by pulse train gaging of the springs, and by water quality at a well upstream of the springs and at the first upstream occurrence of the springs. The travel time of this recharge source is interpreted to be less than 22 years. (Author's abstract)
W84-01553

GEOPHYSICAL LOGGING IN CARBONATE AQUIFERS,
Geological Survey, Spokane, WA. Water Resources Div.
L. M. MacCary.
Ground Water, Vol. 21, No. 3, p 334-342, May-June, 1983. 15 Fig, 8 Ref.

Descriptors: *Logging (recording), *Aquifers, Well logs, Limestone, Dolomite, Porosity, Water quality, Resistivity, Groundwater recharge, Groundwater movement, Water temperature, Saline water.

Some logging methods are inherently superior to others for the analysis of limestone and dolomite aquifers. Three such systems are the density, neutron, and acoustic-velocity logs. Relative percentages of limestone and dolomite, average matrix (grain) densities of the rock mixtures, and porosity of the rock mass can be calculated from density, neutron, and acoustic-velocity logs. Wells drilled before the 1960's generally were logged with an uncalibrated neutron tool. In some instances, the resultant curve can be empirically calibrated. With supporting data from resistivity logs, apparent water resistivity (Rwa) can be estimated. Depending on rock and mud resistivities, the two most useful resistivity curves for water quality studies are the deeply-focused laterolog and the induction log. For older wells, the standard electric log may be used, if the drilling mud is not salt-saturated. Rwa contour maps derived from geophysical data are useful to outline areas of recharge, direction of probable groundwater flow, and location and salinity of brine areas. Another useful application of well logs is estimation of ground-water temperature. These temperatures are obtained from maximum-reading thermometer data that generally are recorded on each logging run. Maps of porosity can be used to outline potential areas for completing large-yield wells. (Author's abstract)
W84-01554

AQUEOUS GEOCHEMISTRY AND THE EXCHANGEABLE CATION COMPOSITION OF GLAUCONITE IN THE AQUIA AQUIFER, MARYLAND,
Geological Survey, Towson, MD.
For primary bibliographic entry see Field 2K.
W84-01555

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 2. GROUNDWATER MONITORING DEVICES,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W84-01685

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 4. A NATURAL-GRADIENT DISPERSION TEST,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W84-01687

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 5. CATION MIGRATION IN THE DISPERSION TEST,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W84-01688

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 6. HYDROGEOCHEMISTRY,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W84-01689

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 7. DC, VLF, AND INDUCTIVE RESISTIVITY SURVEYS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W84-01690

GROUNDWATER RECHARGE THROUGH A HEAVY-TEXTURED SOIL,
Department of Agriculture, Lethbridge (Alberta). Irrigation Div.
M. J. Hendry.
Journal of Hydrology, Vol. 63, No. 3-4, p 201-209, June, 1983. 5 Fig, 11 Ref.

Descriptors: *Groundwater recharge, *Soil water, *Soil texture, Tritium, Tracers, Particle size, Fracture permeability, Fracture flow, Intergranular seepage, Alberta, Water table.

A testhole was cored to a depth of 17.4 m ground surface in southern Alberta, Canad 55 samples were collected from the cores at intervals. The soil water was distilled from sample and analyzed for natural tritium and t samples were analyzed for particle-size di tion. The upper 3 m of the stratigraphic s consists of coarse to heavy-textured interb lacustrine deposits. These units are underlai heavy-textured weathered till. The site is a z groundwater recharge with the water table below the ground surface. Water, which e the subsurface environment from ground after 1953, has migrated to the lacustrine-til tact via intergranular seepage and fracture and fractures are transmitting post-1953 re water to depths within the underlying slowl meable unsaturated and saturated till. The or a broad tritium peak immediately below the table may be the result of an increasing fr density at this depth. In addition, diffusion tium from the fractures into the adjacent material appears to occur both above and the water table. (Moore-IVI)
W84-01691

AN INTEGRATED APPROACH TO HY GEOLOGIC INVESTIGATIONS - A CASE TORY,
Department of Agriculture, Lethbridge (Alt
M. J. Hendry, R. W. Gillham, and J. A. Cher
Journal of Hydrology, Vol. 63, No. 3-4, p 21 June, 1983. 11 Fig, 1 Tab, 13 Ref.

Descriptors: *Nitrates, *Groundwater, *G drology, *Solute transport, *Denitrification, aquifers, Geochemistry, Isotope studies, Si tion, Mathematical models.

Several investigative techniques were appli occurrence and migration of nitrate in a thi m) phreatic sand aquifer beneath agricultural At an early stage in the investigation, high n concentrations were found at shallow depths aquifer, while at greater depth in the aquif nitrate concentration was close to zero. The face between the shallow groundwater cont nitrate and the deeper nitrate-free water was throughout the study area. Two explanatio the nitrate distribution were considered: the low high-nitrate water originated as infilt through the soil of the study area and the d nitrate-free water entered the study area fro gradient of the study area; and the vertical n distribution was the result of denitrification aquifer. Through the application of physica drogeologic methods of investigation (test dr groundwater instrumentation, hydraulic-head itoring and hydraulic conductivity measurem geochemical studies (major-ion analyses, pH dissolved oxygen, methane and alkalinity), ronmental isotope studies (O18, deuterium an tium), numerical simulations of groundwater and solute transport and an analytical soluti solute transport, it was shown that denitrificat the principal cause of the nitrate distributio the first hypothesis was invalid. Denitrificatio be an important process in groundwaters regional scale. Without the application of an grated approach, the importance of the denitr tion process would probably not have been r nized and confirmed. Although not easily a pated, it is possible that over-interpretation sults from any one of the study methods have produced erroneous conclusions. (M IVI)
W84-01692

ORIGIN OF DISSOLVED SOLIDS GROUNDWATERS OF MAYNE ISL BRITISH COLUMBIA, CANADA,
Waterloo Univ. (Ontario). Dept. of Earth Scie
R. A. Dakin, R. N. Farvolden, J. A. Cherry, a P. Fritz.
Journal of Hydrology, Vol. 63, No. 3-4, p 233 June, 1983. 20 Fig, 3 Tab, 35 Ref.

Descriptors: *Dissolved solids, *Saline w Groundwater, Hydrochemistry, Geohydro Isotope studies, Sodium, Chloride, Shale, Gro

movement, Meteoric water, Leaching, , Molecular diffusion, Seawater.

geological, hydrochemical and isotope tech- were applied to determine the origin of groundwaters on Mayne Island in the Strait orgia, British Columbia. The saline ground- is a sodium chloride type, with concentra- f Na(+) and Cl(-) as high as 4367 and 8008 respectively. Leach tests on twenty rock s from boreholes indicate that the shale in the Cretaceous bedrock have Cl(-) con- ions ranging up to 900 ppm by weight and concentrations up to 2070 ppm. The salt ly originated in the shale during periods of positional compaction, or during periods of sion in ocean water during episodes of gla- ading and erosion during Pleistocene time. resent flow regime of active flushing of ic water through the surficial sediments and ntary bedrock of Mayne Island began as the emerged from below sea level during the glaciation. The salt content of the present- oundwater can be accounted for by the slow through molecular diffusion, of Na(+) and om the low-permeability matrix of the shale active paths of groundwater flow in frac- the shale and in sandstone strata. Intrusion an water under the present hydrologic on the island, and upward flow of brine eep zones within the regional sedimentary re believed to be relatively unimportant utors of salt to the active groundwater flow . O18, deuterium and tritium concentra- re rather uniform for both surface waters oundwaters on Mayne Island and a meteoric is suggested. Saline spring waters on an t island were found to have high O18 and entrations (delta O18 = +6.5 0/00, delta O 0/00), suggesting a sedimentary basin brine, ere is no evidence that these brines are with Mayne Island groundwater. (Author's t)
693

CAL RECHARGE TO A CONFINED STONE IN NORTHWEST SRI LANKA,
e of Hydrology, Wallingford (England).
awrence, and H. A. Dharmagunawardena.
of Hydrology, Vol. 63, No. 3-4, p 287-297, 983. 5 Fig, 2 Tab, 11 Ref.

tors: *Groundwater recharge, *Confined , Leakage, Limestone aquifers, Recharge ir, Hydrochemistry, Pumping tests, Sri

ater resources of a Miocene limestone in northwest Sri Lanka were investigated. estone aquifer receives recharge although ied beneath a thick sequence of Quaternary of low permeability which cover the basin. Hydrochemical and pumping-test ow that this recharge occurs as leakage the semi-permeable cover. The observed a significant response of the water table he semi-permeable cover to pumping of the e aquifer agrees well with theorectical pre- . This semi-permeable cover acts as a re- reservoir allowing pumping from the lime- proceed even during periods of extended . (Author's abstract)
695

LVED IONS, STABLE AND RADIOAC- ISOTOPES AND NOBLE GASES IN AL WATERS OF SOUTH AFRICA,
ity of the Witwatersrand, Johannesburg Africa). Nuclear Physics Research Unit.
nary bibliographic entry see Field 2J.
696

PORATION OF PRIOR INFORMA- ON PARAMETERS INTO NONLINEAR SSION GROUNDWATER FLOW LS; 2. APPLICATIONS,
ical Survey, Denver, CO.
ooley.
Resources Research, Vol. 19, No. 3, p 662- e, 1983. 22 Fig, 5 Tab, 10 Ref.

Descriptors: *Groundwater movement, *Mathematical models, Nonlinear regression, Errors, Water level, Nevada, Washoe County, Truckee Meadows.

In projects involving groundwater modeling, two independent numerical data sets normally exist: a set of water level observations, called sample information, and a set of measurements or calculations of the system parameters, called prior information. Factors influencing the degree of improvement in estimates of parameters of a nonlinear regression groundwater flow model by incorporating prior information of unknown reliability were investigated. If the parameters are properly scaled, linearized expressions for the mean square error (MSE) in parameter estimates of a nonlinear model will often behave very nearly as if the model were linear. By using prior information, the MSE in properly scaled parameters can be reduced greatly over the MSE of ordinary least squares estimates of parameters. Plots of estimated MSE and the estimated standard deviation of MSE versus an auxiliary parameter (the ridge parameter) specifying the degree of influence of the prior information on regression results can help determine the potential for improvement of parameter estimates. Proposed criteria can be used to make appropriate choices for the ridge parameter and another parameter expressing degree of overall bias in the prior information. Results of a case study of Truckee Meadows, Reno-Sparks area, Washoe County, Nevada, conform closely to the results of the hypothetical problem. In the Truckee Meadows case, incorporation of prior information did not greatly change the parameter estimates from those obtained by ordinary least squares. Both sets of estimates are more reliable than suggested by the standard errors from ordinary least squares. (Moore-IVI)
W84-01709

A GEOSTATISTICAL APPROACH TO THE INVERSE PROBLEM IN GROUNDWATER MODELING (STEADY STATE) AND ONE-DIMENSIONAL SIMULATIONS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
P. K. Kitanidis, and E. G. Vomvoris.
Water Resources Research, Vol. 19, No. 3, p 677-690, June, 1983. 10 Fig, 44 Ref. NSF grant CME-8106577.

Descriptors: *Permeability, *Hydraulic head, *Groundwater, Mathematical modeling, Simulation, Geostatistics, Geohydrology.

The problem of estimating hydrogeologic parameters, in particular, permeability, from input-output measurements is reexamined in a geostatistical framework. The field of unknown parameters is represented as a 'random field' and the estimation procedure consists of two main steps. First, the structure of the parameter field is identified, i.e. mathematical representations of the variogram and the trend are selected and their parameters are established by using all available information, including measurements of hydraulic head and permeability. Second, linear estimation theory is applied to provide minimum variance and unbiased point estimates of hydrogeologic parameters (kriging). Structure identification is achieved iteratively in three substeps: structure selection, maximum likelihood estimation, and model validation and diagnostic checking. The methodology was extensively tested through simulations on a simple one-dimensional case. The results are remarkably stable and well behaved. The estimated field is smooth, while small-scale variability is statistically described. As the quality of measurements improves, the procedure reproduces more features of the original field. The results are also shown to be rather insensitive to deviations from assumptions about the geostatistical structure of the field. (Author's abstract)
W84-01710

EXPERIMENTAL INVESTIGATIONS OF UNCONFINED AQUIFER POLLUTION FROM RECHARGE BASINS,
Atomic Energy of Canada Ltd., Pinawa (Manitoba).
For primary bibliographic entry see Field 5B.
W84-01713

NUMERICAL STUDIES OF THE HEAT AND MASS TRANSPORT IN THE CERRO PRIETO GEOTHERMAL FIELD, MEXICO,
California Univ., Berkeley. Lawrence Berkeley Lab.
M. J. Lippmann, and G. S. Bodvarsson.
Water Resources Research, Vol. 19, No. 3, p 753-767, June, 1983. 22 Fig, 5 Tab, 34 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Geothermal resources, *Mass transfer, *Heat, Mathematical models, Simulation, Groundwater recharge, Computer models, Cerro Prieto Geothermal Field, Mexico.

Numerical simulation techniques are employed in studies of the natural flow of heat and mass through the Cerro Prieto reservoir, Mexico and of the effects of exploitation on the field's behavior. The reservoir model is a two-dimensional vertical east to west-southwest cross section, which is based on a recent hydrogeologic model of this geothermal system. The numerical code MULKOM is used in the simulation studies. The steady state pressure and temperature distributions are computed and compared against observed preproduction pressures and temperatures: a reasonable match is obtained. A natural hot water recharge rate of about 0.001 kg/s per meter of field length (measured in a north-south direction) is obtained. The model is then used to simulate the behavior of the field during the 1973-1978 production period. The response of the model to fluid extraction agrees to what has been observed in the field or postulated by other authors. There is a decrease in temperatures and pressures in the produced region. No extensive two-phase zone develops in the reservoir because of the strong fluid recharge. Most of the fluid recharging the system comes from the colder regions located above and west of the produced reservoir. (Author's abstract)
W84-01719

EFFICIENT FINITE ELEMENT TECHNIQUE FOR MODELING TRANSPORT IN FRACTURED POROUS MEDIA; 1. SINGLE SPECIES TRANSPORT,
GeoTrans, Inc., Reston, VA.
P. S. Huyakorn, B. H. Lester, and J. W. Mercer.
Water Resources Research, Vol. 19, No. 3, p 841-854, June, 1983. 15 Fig, 5 Tab, 21 Ref. DOE contract E512-02900.

Descriptors: *Solute transport, *Porous media, *Geologic fractures, Mathematical models, Simulation, Differential equations, Diffusion.

A mathematical model is presented for numerical simulation of solute transport in naturally fractured porous media. The model is based on the dual-porosity conceptual approach and is capable of simulating interactions between porous rock matrix and fractures. Unlike earlier dual-porosity transport models, which rely on parallel fracture assumptions, the present model is a unified model that is also able to represent blocky fractured systems (i.e., systems with suborthogonal fractures) by using a spherical idealization of matrix blocks. Two governing, partial differential equations are written for solute transport in the fractures and diffusion in the porous matrix blocks. These equations are coupled by mass flux terms (leakages). An efficient numerical scheme is presented for approximating the governing transport equations. The scheme effectively combines a two-dimensional, upstream-weighted, finite-element approximation for transport in the fractures with a one-dimensional Galerkin approximation for diffusion within the individual matrix blocks. Coupling of the two approximations is performed implicitly. The systems of algebraic equations resulting from both finite-element approximations are solved by using sequential solution algorithms designed especially for this type of problem. Stability and accuracy of the numerical scheme are checked by applying the model to a number of test problems and comparing results with available analytical

solutions. In all cases the numerical scheme is found to be highly stable and capable of producing reliable results with the use of relatively coarse spatial and temporal discretizations. Finally, the utility of the model is demonstrated by applying it to a hypothetical, yet realistic, problem. (Author's abstract)
W84-01726

2G. Water In Soils

EXTRACTION AND CHEMICAL ANALYSIS OF INTERSTITIAL WATER FROM SOILS AND ROCKS,
Institute of Geological Sciences, London (England). Hydrogeology Unit.
D. G. Kinniburgh, and D. L. Miles.
Environmental Science and Technology, Vol. 17, No. 6, p 362-368, June, 1983. 2 Fig, 7 Tab, 19 Ref.

Descriptors: *Interstitial water, *Soil water, Chalk, Solutes, Chemical analysis, Clays, Organic carbon, Spectrometry, Topsoil.

Interstitial water was extracted from field-moist soils and chalk by immiscible displacment with a dense, inert fluorocarbon liquid. The only special equipment required is a high-speed centrifuge. Yields of interstitial water from soils at field capacity are typically 20-50% of the total water present; yields from chalk range up to 90%. The interstitial water was analyzed for about 20 solutes principally by inductively coupled plasma emission spectrometry. The water extracted from a chalk sample appeared to be representative of all the water present, but with a clay soil, there was evidence of some fractionatiion of NO3-N. Organic carbon (0.002 to 0.007 M) was frequently the most abundant solute in the solutions extracted from ten topsoils. Other typical solute concentrations were in the range 0.001 to 0.0001 M for NO3-N, Na, Mg, Si, S, Cl, K, and Ca and less than 0.000001 M for the trace elements Cu, Zn, and Ba. (Author's abstract)
W84-01505

COMPETITIVE ADSORPTION DURING SOLUTE TRANSPORT IN SOILS: 1. MATHEMATICAL MODELS,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
V. Murali, and L. A. Aylmore.
Soil Science, Vol. 135, No. 3, p 143-150, March, 1983. 22 Ref.

Descriptors: *Leaching, *Mathematical models, *Solute transport, Adsorption, Soil-water-plant relationships, Competitive adsorption, Isotopic exchange, Convection, Dispersion.

One-dimensional, convective-dispersive-adsorptive flow models, in Cartesian and polar coordinates, representing flow of chemicals in soils (e.g., leaching) and toward plant roots, are generalized to competitive multispecies systems. Langmuir-type competitive adsorption models suitable for equilibrium and dynamic interactions are presented, and a few special simplified cases are discussed. Freundlich-type equilibrium adsorption models are modified to multispecies situations. An empirical approach, capable of handling most general equilibrium adsorption isotherms, suitable for multispecies systems, is also described. The empirical approach is comparable to equilibrium Langmuir and Freundlich-type competition in binary systems. Isotopic exchange, which is a form of competition between isotopes of the species for adsorption or exchange sites, may be described through a simple McKay-type equation. (Author's abstact)
W84-01596

ESTIMATING SOIL MOISTURE STORAGE IN THE ROOT ZONE FROM SURFACE MEASUREMENTS,
Computer Sciences Corp., Silver Spring, MD.
P. Camillo, and T. J. Schmugge.
Soil Science, Vol. 135, No. 4, p 245-264, April, 1983. 18 Fig, 9 Tab, 21 Ref.

Descriptors: *Soil water, *Mathematical models, *Simulation, *Roots, Soil water suction, Soil texture, Root zone, Remote sensing, Matric suction profile.

Numerical simulations of the dynamics of soil water in the root zone of a vegetated field show that the matric suction profile can eventually acquire the same shape as the relative root density profile. The suction at any depth is proportional to the corresponding root density raised to a power that depends on soil texture. This behavior is found only for fully grown root systems when the soil water distribution is controlled primarily by the water absorption by the roots; this becomes more likely as the soil dries out. That this power law is a solution of the continuity equation will also be demonstrated analytically. This functional relationship is used to show that, under these restrictive conditions, root zone soil moisture storage is a linear function of volumetric moisture at a particular depth, with the slope changing with depth but fixed in time. This hypothesis is supported by both laboratory and field soil moisture profile measurements, which were taken in fields with fully grown plants. No other model parameters need to be estimated, and the good agreement found constitutes an independent validation of the soil water extraction model under the plant and soil conditions described. Potential applications of these results include estimating soil moisture storage in the root zone from remotely sensed surface soil moisture and estimating the root profile from matric potential profile measurements. (Author's abstract)
W84-01598

GROUNDWATER RECHARGE THROUGH A HEAVY-TEXTURED SOIL,
Department of Agriculture, Lethbridge (Alberta). Irrigation Div.
For primary bibliographic entry see Field 2F.
W84-01691

SIMULATION MODEL OF THE WATER BALANCE OF A CROPPED SOIL: SWATRE,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
C. Belmans, J. G. Wesseling, and R. A. Feddes.
Journal of Hydrology, Vol. 63, No. 3-4, p 271-286, June, 1983. 6 Fig, 27 Ref.

Descriptors: *Soil-water-plant relationships, *Mathematical models, *Water uptake, *Roots, Soil water, Boundary conditions, Rainfall, Evaporation, Transpiration, Soil saturation.

A transient one-dimensional finite-difference model for the unsaturated zone with water uptake by roots is presented. A number of boundary conditions is given for the top and the bottom of the system. At the top, 24-hr. data on rainfall, potential soil evaporation and potential transpiration are needed. When the soil system remains unsaturated, one of the three bottom boundary conditions can be used: pressure head, zero flux or free drainage. When the lower part of the system remains saturated, one can either give the groundwater level or the flux through the bottom of the system as input. In the latter case the groundwater level is computed. (Author's abstract)
W84-01694

GAMMA NEUTRON METHOD APPLIED TO FIELD MEASUREMENT OF HYDRODYNAMIC DISPERSION,
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
F. Brissaud, A. Pappalardo, and Ph. Couchat.
Journal of Hydrology, Vol. 63, No. 3-4, p 331-343, June, 1983. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Solute transport, *Irrigation effects, Hydrodynamics, Dispersion, Pore water, Gamma neutron method, Deuterium.

Solute movements during field irrigations were studied under steady-state and transient hydrodynamic conditions. The gamma neutron method was used to monitor a deuterated water pulse along a vertical profile in field test plots. Two different types of behavior were revealed by the test resu
In the first, the labeled water pulse velocity mat
es the conservation of the vertical rate of wa
and, when the deuterated water concentration p
files are mass-conservative, the experimental
sults are accurately described by the equation
dispersion. In the second, the pore water veloc
differs considerably from that of strictly verti
displacements and the concentration profiles
not mass-conservative. Two tests carried out
the same plot under similar conditions seve
weeks apart can show both types of behavi
(Moore-IVI)
W84-01697

UNSTEADY FLOW AGAINST DISPERSION IN FINITE POROUS MEDIA,
Banaras Hindu Univ., Varanasi (India). Dept. Mathematics.
N. Kumar.
Journal of Hydrology, Vol. 63, No. 3-4, p 345-3
June, 1983. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Unsteady flow, *Dispersion, Poro
ity, Flow, Velocity, Water quality, Mathematic
studies.

Analytical solutions are presented for dispersi
(in a finite non-adsorbing and adsorbing poro
medium) which is controlled by flow (with u
steady unidirectional velocity distribution) of a lo
concentration fluid towards a region of high
concentration. Such a situation often occurs
practice when poor quality water is prevent
from spreading by a flow of fresh water. An exp
nential function concentration is enforced at t
source of dispersion, while zero concentration, o
condition in which the change in concentration
proportional to the flow, is applied at the oth
boundary. A new time variable has been intr
duced to solve the unsteady flow problem. B
observing the flow velocities initially and at diffe
ent times as the flow advances, the time variab
can be calculated. (Moore-IVI)
W84-01698

GEOSTATISTICAL APPROACH TO TH TRICKLE IRRIGATION DESIGN IN HETERO GENEOUS SOIL; 1. THEORY,
Agricultural Research Organization, Bet-Dag
(Israel). Div. of Soil Physics.
D. Russo.
Water Resources Research, Vol. 19, No. 3, p 63
642, June, 1983. 9 Fig, 21 Ref.

Descriptors: *Trickle irrigation, *Permeability c
efficient, *Soil water, *Head, *Irrigation desig
Spatial distribution, Crop yield, Soil hydraulic
Statistical methods, Geostatistics.

A geostatistical approach was used to investiga
the spatial variability of two measured soil hydra
lic parameters, the saturated hydraulic conductiv
ity Ks and alpha = d(log K(h))/(d(h)), where K
the hydraulic conductivity and h is the soil wate
pressure head. Using a linearized solution to stead
infiltration from a circular shallow pond, the spa
tial distribution of the midway soil water pressu
head between emitters, he (for a given trickl
discharge rate Q and spacing between emitters, d
was calculated using the spatially variable soil pa
rameters K, and alpha. The spatial distribution o
the crop yield Y was calculated from the spatiall
variable he by using a quadratic expression of th
Y(he) relationships. It was found that the spati
variability of each of the measured input paran
eters (Ks and alpha) or the calculated output vari
bles (he and Y) is expressed through the variogra
gamma and can be characterized in terms of th
coefficient of variation CV and the integral scale
In the case of log Ks, for which the sill is reache
at relatively small range, two different gamma
were tested. Results showed that the kriged valu
of log Ks as well as the resultant values of he
he(Ks alpha; d, Q) were relatively insensitive t
the selected gamma. The spatial variability of h
reduced the average (over the field) crop yield th
would have been obtained when he was uniform
throughout the field. The spatially variable so
parameters Ks and alpha were used to calculate th

l distribution of the spacing between emitters equired to achieve (for a given trickle dis-e) a prespecified value of he uniform ghout the field. It was found that the use of a lly variable d increased the field crop yield % relative to the yield that was obtained when le-valued d uniform throughout the field was The spatial distribution of d was combined hydraulic principles to derive the spatial dis-ion of lateral diameter and length for engi-ng design requirements. (Author's abstract) 01706

ELING TRITIUM AND CHLORIDE 36 NSPORT THROUGH AN AGGREGATED OL,
rnia Univ., Davis. Dept. of Land, Air and r Resources.
edi-Kizza, J. W. Biggar, M. Th. van chten, P. J. Wierenga, and H. M. Selim.
r Resources Research, Vol. 19, No. 3, p 691-une, 1983. 11 Fig, 5 Tab, 27 Ref.

iptors: *Soil water, *Chloride, *Solute trans-Breakthrough, Steady flow, Saturated soils, ation, Mathematical models, Convection, sion, Isotopic tracers, Interstitial water, Ve-, Tritium.

through curves (BTC's) of tritiated H2O and simultaneously displaced through columns of us-sized aggregates of an Ione Oxisol soil measured under water-saturated steady flow ions. The data were simulated using two ptual models. In model I, all soil water was ed to be mobile with a physical equilibrium g in the system. For model II, soil water was oned into mobile and immobile regions. Con-e diffusive solute transport was limited to the e water region. Transfer of a tracer between o soil water regions was assumed to occur at proportional to the difference in tracer con-tions between the two regions. Sorption of d H20 and Cl36 was considered to be an taneous linear and reversible process. The nknown parameters in model I and the four wn parameters in model II were estimated ing model predictions to the experimental Model I could only describe BTC's obtained columns packed with small aggregates (0.5-1 nd for displacements run at small fluxes (0.2 , whereas model II described all the BTC's Peclet numbers P in model II, as measured on separate column, were essentially constant, ing a linear relationship between the appar-ffusion coefficient D and the mobile pore velocity vm. The fraction of soil water that bile, phi, and the mass transfer coefficient were found to be a function of the physical hemical properties of the porous medium gate size, pore water velocity, and solution ntration). (Author's abstract) 1711

MATING SPATIAL VARIABILITY IN MOISTURE WITH A SIMPLIFIED DY-C MODEL,
and Univ., College Park. Dept. of Civil En-ng.
Clapp, G. M. Hornberger, and B. J. Cosby.
Resources Research, Vol. 19, No. 3, p 739-ne, 1983. 5 Fig, 3 Tab, 16 Ref.

ptors: *Soil water, *Mathematical models, l variability, Topography, Soil physical ties, Scaling theory, Wetting front, Simula-nfiltration, Precipitation, Chickasha, Oklaho-

raphic effects, soil heterogeneity, and spatial lity in precipitation and vegetation may variability in measured soil moisture. Scal-eory has been suggested as a promising tool scribing soil heterogeneity and, consequent-ortion of spatial variability of measured soil re. The appropriateness of ascribing soil re variability to heterogeneity of soil prop-s investigated through the use of a model of oisture dynamics and scaling theory. The termed a wetting front model, is a simpli-epresentation of water movement in soils. The model conceptually depicts the moisture profile as discrete blocks of soil moisture separated by sharp fronts. Probabilistic simulations were run with input data appropriate to watersheds R-5 and R-7 at Chickasha, Oklahoma. Variability due to soil heterogeneity remains relatively constant through time with only slight increases during redistribution following infiltration. A comparison of simulated and observed soil moisture integrated from the surface to the 15-cm depth shows that heterogeneity in soil hydraulic properties may account for approximately 75% of observed standard deviation, or 56% of the variance. By ascribing all of the uncertainty in a soil system to scaled differences in the soil matrix, one may be limiting the mathematical simulator to a certain pattern in the variability in the computed moisture content. (Moore-IVI)
W84-01717

RAINWATER INFILTRATION INTO A BARE LOAMY SAND,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, H. P. Singh, and O. P. Pareek.
Hydrological Sciences Journal, Vol. 28, No. 3, p 417-424, September, 1983. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Infiltration, *Rainfall, *Rainfall impact, *Slope, Soil surfaces, Water harvesting, Slope length, Loamy sand, India.

In order to design micro-catchment water harvesting systems in the Indian desert, rainwater infiltration experiments were conducted on a representative loamy sand soil for a period of six years. Plots with three slopes - 0.5, 5 and 10%, and five slope lengths - 5.12, 7.0, 8.5, 10.75 and 14.5 m were used. With dry antecedent soil conditions, infiltration is governed by rainfall depth, whereas with wet antecedent soil conditions, raindrop impact (intensity) which forms a crust over the soil surface, is the deciding factor. Infiltration decreases significantly with increasing slope due to reduction in the time available for rainfall to infiltrate, but slope length has no significant effect. A graphical multiple curvilinear model to predict rainfall infiltration using rainfall and basin characteristics is developed and the goodness of fit is tested. (Author's abstract)
W84-01765

2H. Lakes

DISTRIBUTION AND ABUNDANCE OF LARVAL BURBOT AND DEEPWATER SCULPIN IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
P. J. Mansfield, D. J. Jude, D. T. Michaud, D. C. Brazo, and J. Gulvas.
Transactions of the American Fisheries Society, Vol. 112, No. 2A, p 162-172, March, 1983. 5 Fig, 2 Tab, 42 Ref.

Descriptors: *Burbot, *Sculpin, *Larvae, *Lake Michigan, Spawning, Distribution, Entrainment, Water temperature, Fish populations.

Samples from seven locations at depths to 21 m, collected over periods of up to 8 years, were used to describe the nearshore distribution and abundance of burbot Lota lota and deepwater sculpin Myoxocephalus thompsoni larvae in Lake Michigan. Based upon power-plant-entrainment samples and field collections, burbot larvae (3.0-7.5 mm) occurred from late March to mid-June, most abundantly in April and May, and most often at water temperatures of 6-12 C. Larvae were collected from the 0.5- to 13.5-m depth strata as far lakeward as the 21-m bottom contour, the limit of offshore sampling. In eastern Lake Michigan, highest densities (up to 843 larvae/1,000 cu m) were at the 1-m contour; in Green Bay, up to 24,000 larvae/1,000 cu m were detected near the Bark River. High densities of burbot larvae at bottom depths 3 m and less indicated inshore spawning and river spawning at some sites. Deepwater sculpin larvae first occurred in early February and were common in March and April entrainment samples. Larvae (8.0-22.0 mm) were in nearshore waters usually through May at depth strata of 0.5 to 17 m as far lakeward as the 18-m bottom contour. Most larvae occurred at water temperatures below 6 C. Field densities were low, 5 to 78 larvae/1,000 cu m. Deepwater sculpin larvae were pelagic and were dispersed over great distances by currents. (Author's abstract)
W84-01401

COMPARISON OF TWO ICHTHYOPLANKTON SAMPLING GEARS WITH NOTES ON MICRODISTRIBUTION OF FISH LARVAE IN A LARGE RIVER,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
For primary bibliographic entry see Field 7B.
W84-01406

DIEL DRIFT AND FEEDING OF CHANNEL CATFISH ALEVINS IN THE ILLINOIS RIVER, ARKANSAS,
Arkansas Game and Fish Commission, Hot Springs.
M. L. Armstrong, and A. V. Brown.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 302-307, March, 1983. 1 Fig, 1 Tab, 35 Ref.

Descriptors: *Fish, *Larvae, *Drift, *Fish food, Catfish, Alevins, Invertebrates, Midges, Water currents, Illinois River, Arkansas.

The downstream displacement, or drift, of fish larvae in lotic ecosystems has, in addition to its intrinsic interest, practical importance whenever withdrawals of water are contemplated for industrial or other uses. It is not clearly understood why larval fish drift, but it has been suggested that the fish are feeding on drifting invertebrates. The food habits of 317 channel catfish Ictalurus punctatus alevins (standard length 14-16 mm) collected from the Illinois River, Arkansas were investigated to determine if the drifting alevins were using drifting invertebrates as a food resource. Drift of alevins coincided with increases in fullness of their stomachs, but alevins had been feeding predominantly on chironomid larvae and pupae, which were rare in the drift and riffle substrate. Alevins apparently fed on chironomids in upstream pools and accidentally encountered swift currents that caused them to drift downstream. If so, drift was a consequence of feeding activity, not an aid to it. (Moore-IVI)
W84-01409

SPAWNING AND EARLY-LIFE ECOLOGICAL PHASES OF THE WHITE SUCKER IN JACK LAKE, ONTARIO,
Trent Univ., Peterborough (Ontario). Dept. of Biology.
B. Corbett, and P. M. Powles.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 308-313, March, 1983. 5 Fig, 3 Tab, 23 Ref.

Descriptors: *Sucker, *Spawning, Growth, Water temperature, Drift, Fish food, Hatching, Marinas, Channels, Jack Lake, Ontario.

In 1979, peak spawning of white suckers Catostomus commersoni occurred on April 20-21 (9-15 C and 17-22 C) at night over fast riffle in a tributary of Jack Lake. Eggs hatched in 16 days and drift occurred in 27-29 days; maximum drift occurred between 2100 and 0100 hours. An estimated 11,800 postlarvae drifted to the nursery, a new boat channel and marina area in Jack Lake. Postlarvae phase 1 (terminal mouth, 15-17 mm total length, TL) and phase 2 (subterminal mouth, 18-34 mm TL) were spent in the nursery. At 28 C (midsummer), phase-3 fish (35-84 mm TL) moved out to the lake shores near the nursery, and later dispersed into the lake basin. Growth of white suckers was slower in phase 1 than in phase 2, and diets differed slightly between these intervals. Phase-3 fish did not grow significantly faster than phase-2 fish in spite of their more diverse diet. The cooler lake habitat may account for a lack of surge in the growth rate of phase-3 fish, or diversity of food may be an indica-

tion of food scarcity away from the nutrient-rich nursery area. (Author's abstract)
W84-01410

IDENTIFICATION OF CATOSTOMID LARVAE IN PYRAMID LAKE AND THE TRUCKEE RIVER, NEVADA,
Colorado State Univ., Fort Collins. Larval Fish Lab.
D. E. Snyder.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 333-348, March, 1983. 10 Fig, 5 Tab, 37 Ref.

Descriptors: *Spawning, *Larvae, *Suckers, Distribution, Pyramid Lake, Truckee River, Nevada.

As adults, mountain suckers Catostomus platyrhynchus inhabit the Truckee River, Tahoe suckers Catostomus tahoensis both the river and Pyramid Lake, and the endangered cui-ui Chasmistes cujus the lake only, except during the spawning season. All spawn in the river and under certain conditions the latter two species also spawn in the lake. The development of adequate water and fishery management techniques to insure the survival of the endangered cui-ui requires knowledge of the fish's reproductive and early life history requirements. Diagnostic characters useful in identifying most larvae and early juveniles include differences in pigmentation, size at the onset of specific developmental events, and gut and mouth morphologies. Fin-ray counts, myomere counts, and morphometric characters are very similar and of little diagnostic value. Based on these criteria, larvae of the cui-ui were identified in Pyramid Lake collections, and larvae and juveniles of the mountain and Tahoe suckers were identified in both lake and river collections. All the cui-ui were taken in the lake substantial distances from the Truckee River delta, and may represent natural spawning in Pyramid Lake during 1974 and 1975. The presence of mountain suckers in Pyramid Lake had not been previously documented. (Moore-IVI)
W84-01411

MICROHABITATS CHOSEN BY BROWN TROUT FOR FEEDING AND SPAWNING IN RIVERS,
C. S. Shirvell, and R. G. Dungey.
Transactions of the American Fisheries Society, Vol. 112, No. 3, p 355-367, May, 1983, 5 Fig, 7 Tab, 31 Ref.

Descriptors: *Trout, *Spawning, *Feeding, Aquatic habitats, Water depth, Velocity, Fish population, Population dynamics, Substrates, Rivers, New Zealand.

This study's objective was to quantify the water depth, water velocity, and substrate used by adult brown trout Salmo trutta for feeding and spawning in rivers. General hypotheses were: (1) brown trout prefer specific magnitudes of environmental variables and occupy positions through choice; (2) the preferred value of any variable for a particular activity is the same in all rivers; (3) brown trout prefer different values of the same variable for different activities. Surface observation was used to locate 140 feeding and 140 spawning positions used by brown trout in both isolated and sympatric (with rainbow trout Salmo gairdneri) populations in six diverse rivers in New Zealand. Brown trout (mean fork length 42 cm) preferred a mean depth of 65.0 cm and a mean velocity of 26.7 cm/sec at the position occupied by the fish for feeding, but for spawning they preferred a mean depth of 31.7 cm, a mean velocity of 39.4 cm/sec, and a mean substrate size of 14.0 mm. Analysis of variance showed brown trout preferred the same velocity for the same activity in all rivers and years regardless of whether they were from allopatric or sympatric populations, but microhabitats used for feeding and spawning were significantly different. Velocity appeared to be the most important factor determining position choice but ranking of factors may vary with the type of activity. Brown trout chose positions with optimum combinations of depth and velocity instead of positions with more preferred values of either factor alone. Population size maybe limited by the amount of the least abundant activity-specific microhabitat. (Author's abstract)
W84-01412

COMMUNITY ANALYSIS IN FISHERY MANAGEMENT: AN APPLICATION WITH NORTHERN WISCONSIN LAKES,
Wisconsin Univ.-Madison. Center for Limnology.
W. M. Tonn, J. J. Magnuson, and A. M. Forbes.
Transactions of the American Fisheries Society, Vol. 112, No. 3, p 368-377, May, 1983. 5 Fig, 2 Tab, 43 Ref. DEB 79-12337, F-83-R.

Descriptors: *Fisheries, *Lakes, Aquatic habitats, Management, Biological communities, Multivariate analysis, Fish, Water depth, Hydrogen ion concentration, Conductivity, Watersheds, Lake area, Wisconsin.

Decisions in fishery management usually are made on a species-by-species and site-by-site basis because most information about fishes has been collected and organized in this way. A comparative, community-level approach can contribute to the development of management strategies for large sets of lakes and fish assemblages. An approach similar in concept to lake classification uses a technique of multivariate community analysis (ordination, classification, multiple discriminant analysis). This approach can reveal patterns among fish assemblages and relate them to the lakes' habitat characteristics. An application of the approach is illustrated by a published study on fish assemblages of 18 small lakes in northern Wisconsin. Two discrete assemblage types were distinguished and the factors believed to be responsible for their maintenance were identified. With relationships derived from those 18 lakes, predictions of the assemblage types of 11 additional lakes are made from only five habitat characteristics obtained from the literature. The five environmental variables include lake area, maximum depth, pH, watershed size, and conductivity. Analyses showed these predictions to be largely successful. It is suggested that multivariate community analysis contributes to an ability to understand, predict, and manage fish assemblages. (Moore-IVI)
W84-01413

CHANGES IN FISH POPULATIONS OVER AN 80-YEAR PERIOD: BIG PINE LAKE, WISCONSIN,
Wisconsin Univ.-Madison. Center for Limnology.
P. D. Inskip, and J. J. Magnuson.
Transactions of the American Fisheries Society, Vol. 112, No. 3, p 378-389, May, 1983. 5 Fig, 4 Tab, 37 Ref.

Descriptors: *Fish populations, Muskellunge, Walleye, Pike, Bass, Population dynamics, Lake fisheries, Sport fishing, Temperature, Big Pine Lake, Wisconsin.

From 1897 to 1977, landowners recorded sport catches for Big Pine Lake, a 256 hectare lake in northern Wisconsin that has experienced light fishing pressure. The species composition of the catch remained fairly stable for 40 years, from 1897 to 1940, with muskellunge Esox masquinongry, walleye Stizostedion vitreum vitreum, and black bass (Micropterus spp.) all accounting for substantial fractions of the total. Northern pike Esox lucius were first recorded in 1946, apparently having entered after an outlet dam washed out in 1944. Subsequent increases in the proportion of northern pike coincided with declining percentages of muskellunge. By the 1950s, the relative abundance of walleye declined, ultimately almost to zero, while the percentage of bass more than doubled. This change began during the warmest decade on record. By 1977, the walleye population had rebounded, bass had declined to pre-1940 levels, northern pike were abundant, and muskellunge were relatively scarce. Long-term changes in summer temperatures and colonization by northern pike appear to have been important factors causing changes in species composition. Effects of human exploitation have been slight. Although the species composition changed dramatically over the 80 years, the only sustained change has been the substitution of northern pike for muskellunge. (Author's abstract)
W84-01414

COMMUNITY STRUCTURE DYNAMICS EPILITHIC AND EPIPHYTIC DIATOMS MISSISSIPPI STREAM,
Mississippi State Univ., Mississippi State. Dep Biological Sciences.
R. O'Quinn, and M. J. Sullivan.
Journal of Phycology, Vol. 19, No. 2, p 123 June, 1983. 2 Fig, 3 Tab, 25 Ref. A-133-M

Descriptors: *Diatoms, *Aquatic habitats, Bio cal communities, Stream biota, Epilimnion, E ton, Species diversity, Light intensity, Substr Seasonal variation, Mississippi.

Epilithic and epiphytic diatoms were colle monthly from 18 June 1979 through 19 May from both shaded and unshaded sites of Ses Creek, a shallow, oligotrophic and strongly line stream in northeastern Mississippi. The d nant macroalgae were filamentous green alga longing to the nonmucilage genera dophora and Rhizoclonium. Ninety taxa identified, with Navicula minima Grun. and N chia dissipata (Kutz) Grun. accounting for 50 all valves counted. Other important taxa were vicula menisculus var. upsaliensis (Grun.) G N. cryptocephala var. veneta (Kutz) Rabh., nanthes minutissima Kutz. and Cymbela tu (Greg) Cl. With few exceptions, the more d nant taxa were equally abundant in the shaded unshaded sites and also in the epilithon and epi ton. Species diversity (H') and the number of in a sample in all four habitats showed an iden pattern, being lowest in winter and highest in No one pair of habitats were more struct similar than any other pair when compared similarity index (SIMI). Apparently, differenc light intensity and substrate type had little effe diatom distribution in Sessums Creek and it concluded that the locality sampled support single, nearly homogeneous diatom commu (Author's abstract)
W84-01447

MULTIVARIATE ASSESSMENT OF E RONMENTAL PREFERENCES OF CYPRI FISHES OF THE ILLINOIS RIVER, OKLA MA,
Oklahoma Biological Survey, Norman.
J. D. Felley, and L. G. Hill.
American Midland Naturalist, Vol. 109, No April, 1983. 1 Fig, 6 Tab, 24 Ref.

Descriptors: *Fish, *Aquatic environment, Ill River, Oklahoma, Spatial distribution, Fish be ior, Fish food, Aquatic habitats, Spawning, W temperature, Upstream, Downstream, Velocity

Cyprinid fishes were collected from the Oklah drainage of the Illinois River in all seasons of and 1979. The Illinois River and its tributa drain the Ozark Plateau and the Boston Moun and support an Ozarkian Fish fauna. Specie cluded in this analysis were Campostoma an lum, Nocomis asper, Notropis boops, N. nub N. pilsbryi, N. rubellus, N. whipplei, Pimeph notatus, Phoxinus erythrogaster and Semo atromaculatus. Fishes were collected and 17 e ronmental variables measured from each o localities sampled in every season. Species dist tions were characterized in reference to each able as follows: the value of a variable at location was weighted by the number of ind uals of a species present, and the mean of t weighted values was taken as that species' ferred state for that variable. Principal compon analysis, with rotation of the component solu to simple structure, was used to elucidate the tionships among variables in terms of species d butions. In most seasons, components relate species preferences for upstream vs. downstr locations, different foods, and slow- vs. fast-w habitats. For most species, differences in ha preference between seasons were related to br ing (in the spring) and to preference for wa

ations during the rest of the year. (Author's tract)
4-01449

LOROPHYLL A AND ADENOSINE TRI-OSPHATE LEVELS IN ANTARCTIC AND MPERATE LAKE SEDIMENTS,
ginia Polytechnic Inst. and State Univ., Blacks-g. Dept. of Biology.
M. Simmons, Jr., R. A. Wharton, Jr., B. C. ker, and D. Andersen.
rnal of Microbial Ecology, Vol. 9, No. 2, p 123-, July, 1983. 2 Fig, 7 Tab, 50 Ref. 76-23996, 79-05.

scriptors: *Adenosine triphosphate, *Chloro-ll a, *Lake sediments, Trophic level, Antarctic, nperate zone, Benthic algae, Microorganisms, tic state.

alysis of adenosine triphosphate (ATP) from ficial sediment layers in two antarctic lakes and temperate lakes showed a high degree of ilarity in spite of differences between trophic e, mictic state, or geographic location. Adeno- triphosphate was found at all levels sampled in perate lake sediment cores but occasionally present only in surficial layers of antarctic es. Surficial sediment layers from antarctic es contained high chlorophyll a (Chl a) levels to the extensive benthic algal mats which ur there. In some antarctic cores, Chl a was ectable in deep, old mat layers, whereas Chl a not found in any of the temperate lake cores. arctic lake sediments appear to be unique envi-ments where Chl a molecules can remain intact long periods of time due to low light, tempera-, and microbial activity. As such, these lakes important natural laboratories where a long ory of microbial interations can be studied nout metazoan perturbation effects. Although e was much variability in concentration of Chl d ATP between samples, there appears to be relationship between Chl a or ATP levels to tic or trophic states of the lakes. These data gest that sediment microbial communities may independent of environmental and biological perties of the overlying water masses. (Author's ract)
4-01472

ISYMMETRIC VERTICAL CIRCULATION A STRATIFIED RESERVOIR,
hnical Univ. of Szczecin (Poland). Inst. of er Engineering.
Meyer.
rnal of Hydraulic Research, Vol. 21, No. 2, p 151, 1983. 10 Fig, 12 Ref.

criptors: *Water circulation, *Reservoirs, hemetical models, Density stratification, lies, Selective withdrawal.

athematical model of vertical circulation in a sity-stratified reservoir is presented for the case xially symmetric flow, particularly for the flow erated by selective withdrawal. The method olves conditions such as location of intake, tified flow parameters, and various eddy vis-ties in the vertical and horizontal directions. analytical solution of the problem is given in is of Fourier series. The solution covers two ial cases, gradually and continuously converg-channels, for which a mechanism of formation he surface circulation region is described. The hod takes account of additional horizontal den- changes in a reservoir. Those appear to have ificant influence upon the extent of the region irculation. The characteristic features of the pattern are circulation regions at the surface bottom. Within those regions there exist inter-closed eddies which cause vertical circulation vater in a density-stratified reservoir. A source equentially created internal eddies is the corner veen the free water surface and the intake er. (Moore-IVI)
4-01483

E AND BE IN THE MAURICE RIVER-ION LAKE SYSTEM OF SOUTHERN NEW SEY,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemistry.
L. Lundberg, T. Ticich, G. F. Herzog, T. Hughes, and G. Ashley.
Journal of Geophysical Research, Vol. 88, No. C7, p 4498-4504, May 20, 1983. 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Beryllium, *Isotope studies, Lakes, Silicates, Organic matter, Isotopic tracers, Maurice River, Union Lake, New Jersey.

The Be10 and Be contents of 22 samples taken from seven locations in the Maurice River-Union Lake system of southern New Jersey are reported. Bulk Be10 contents range 0.05 to 2.7 dpm/kg and Be from <0.1 to 2 ppm. Silicate minerals separated from Union Lake sediments appear to have a constant surface concentration of about 500,000 atoms Be10/sq cm. Organic material is greatly enriched in Be: hand-picked samples contain over 10 dpm/kg of Be10 and 5 ppm of Be. The deposition rate of Be10 in Union Lake is about 1 atoms/sq cm s. (Author's abstract)
W84-01488

INTERBIOME COMPARISON OF STREAM ECOSYSTEM DYNAMICS,
Idaho State Univ., Pocatello. Dept. of Biology.
G. W. Minshall, R. C. Petersen, K. W. Cummins, T. L. Bott, and J. R. Sedell.
Ecological Monographs, Vol. 53, No. 1, p 1-25, 1983. 19 Fig, 10 Tab, 63 Ref.

Descriptors: *Ecosystems, *Streams, *Organic matter, Stream order, Productivity, Watersheds, Headwaters, Aquatic environment, Turnover time, Velocity, Decomposition, Leaf pack, Aquatic biota.

Studies were conducted in four distinct geographic areas (biomes/sites) in northern United States to examine changes in key ecosystems parameters; benthic organic matter (BOM), transported organic matter (TOM), community production and respiration, leaf pack decomposition, and functional feeding-group composition along gradients of increasing stream size. Four stations ranging from headwaters (1st or 2nd order) to midsized rivers (5th to 7th order) were examined at each site using comparable methods. The results for each parameter are presented and discussed in each site using comparable methods. The results for each parameter are presented and discussed in light of the River Continuum Concept of Vannote et al. (1980). The postulated gradual change in a stream ecosystem's structure and function is supported by this study. However, regional and local deviations occur as a result of variations in the influence of: (1) watershed climate and geology, (2) riparian conditions, (3) tributaries, and (4) location-specific lithology and geomorphology. In particular, the continuum framework must be visualized as a sliding scale which is shifted upstream or downstream depending on macroenvironmental forces (1 and 2) or reset following the application of more localized 'micro'-environmental influences (3 and 4). Analysis of interactions between BOM and TOM permitted evaluation of stream retentiveness for organic matter. Headwaters generally were most retentive and downstream reaches the least. Estimates of organic matter turnover times ranged between 0.2 and 14 yr, and commonly were 1-4 yr. Both turnover times and distances were determined primarily by the interaction between current velocity and stream retention. Biological processes played a secondary role. However, the streams varied considerably in their spiraling of organic matter due to differences in the interplay between retentiveness and biological activity. Differences in the relative importance of retention mechanisms along the continuum suggests that headwater stream ecosystems may be functionally more stable, at least to physical disturbances, than are their intermediate river counterparts. (Author's abstract)
W84-01644

POPULATION ECOLOGY OF NITRIFIERS IN A STREAM RECEIVING GEOTHERMAL INPUTS OF AMMONIUM,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
A. B. Cooper.
Applied and Environmental Microbiology, Vol. 45, No. 4, p 1170-1177, April, 1983. 3 Fig, 4 Tab, 19 Ref.

Descriptors: *Nitrification, *Bacteria, *Ammonium, Geothermal water, Nitrates, Sediments, Oxygenation, Nitrosospira, Nitrosomomas.

The distribution, activity, and generic diversity of nitrifying bacteria in a stream receiving geothermal inputs of ammonium were studied. The high estimated rates of benthic nitrate flux (33 to 75 mg of N/sq m/h) were a result of the activity of nitrifiers located in the sediment. Nitrifying potentials and ammonium oxidizer most probable numbers in the sediments were at least one order of magnitude higher than those in the waters. Nitrifiers in the oxygenated surface (0 to 2 cm) sediments were limited by suboptimal temperature, pH, and substrate level. Nitrifiers in deep (nonsurface) oxygenated sediments did not contribute significantly to the changes measured in the levels of inorganic nitrogen species in the overlying waters and presumably derived their ammonium supply from ammonification within the sediment. Ammonium-oxidizing isolates obtained by a most probable number nonenrichment procedure were species of either Nitrosospira or Nitrosomonas, whereas all those obtained by an enrichment procedure (i.e., selective culture) were Nitrosomonas spp. The efficiency of the most-probable-number method for enumerating ammonium oxidizers was calculated to be between 0.05 and 2.0%, suggesting that measurements of nitrifying potentials provide a better estimate of nitrifying populations. (Author's abstract)
W84-01646

METHANOGENESIS FROM METHANOL AND METHYLAMINES AND ACETOGENESIS FROM HYDROGEN AND CARBON DIOXIDE IN THE SEDIMENTS OF A EUTROPHIC LAKE,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
D. R. Lovley, and M. J. Klug.
Applied and Environmental Microbiology, Vol. 45, No. 4, p 1310-1315, April, 1983. 1 Fig, 4 Tab, 21 Ref.

Descriptors: *Metabolism, *Methanogenesis, *Acetogenesis, *Sediments, Eutrophic lakes, Methanol, Methylamines, Carbon dioxide, Hydrogen, Acetates, Wintergreen Lake, Michigan.

Carbon-14 tracer techniques were used to examine the metabolism of methanol and methylamines and acetogenesis from hydrogen and carbon dioxide in sediments from the profundal and littoral zones of eutrophic Wintergreen Lake, Michigan. Methanogens were primarily responsible for the metabolism of methanol, monomethylamine, and trimethylamine and maintained the pool size of these substrates below 10 micro M in both sediment types. Methanol and methylamines were the precursors for less than 5 and 1%, respectively, of the total methane produced. Methanol and methylamines continued to be metabolized to methane when the sulfate concentration in the sediment was increased to 20mM. Less than 2% of the total acetate production was derived from carbon dioxide reduction. Hydrogen consumption by hydrogen-oxidizing acetogens was 5% or less of the total hydrogen uptake by acetogens and methanogens. These results, in conjunction with previous studies, emphasize that acetate and hydrogen are the major methane precursors and that methanogens are the predominant hydrogen consumers in the sediments of this eutrophic lake. (Author's abstract)
W84-01648

RADIOASSAY FOR HYDROGENASE ACTIVITY IN VIABLE CELLS AND DOCUMENTATION OF AEROBIC HYDROGEN-CONSUMING BACTERIA LIVING IN EXTREME ENVIRONMENTS,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
B. Schink, F. S. Lupton, and J. G. Zeikus.

Applied and Environmental Microbiology, Vol. 45, No. 5, p 1491-1500, May, 1983. 10 Fig, 2 Tab, 32 Ref.

Descriptors: *Bacteria, *Hydrogenase, *Hydrogen metabolism, *Isotopic tracers, Saline water, Acid water, Thermal water, Aerobic conditions, Desulfovibrio, Clostridium, Methanosarcina, Natural waters, Extreme environments.

An isotopic tracer assay based on the hydrogenase-dependent formation of tritiated water from tritium gas was developed for in life analysis of microbial hydrogen transformation. This method allowed detection of bacterial hydrogen metabolism in pure cultures or in natural samples obtained from aquatic ecosystems. A differentiation between chemical-biological and aerobic-anaerobic hydrogen metabolism was established by variation of the experimental incubation temperature or by addition of selective inhibitors. Hydrogenase activity was shown to be proportional to the consumption or production of hydrogen by cultures of Desulfovibrio vulgaris, Clostridium pasteurianum, and Methanosarcina barkeri. The method was applied, in connection with measurements of free hydrogen and most-probable-number enumerations, in aerobic natural source waters to establish the activity and document the ecology of hydrogen-consuming bacteria in extreme acid, thermal, or saline environments. The utility of the assay is based in part on the ability to quantify bacterial hydrogen transformation at natural hydrogen partial pressures, without the use of artificial electron acceptors. (Author's abstract)
W84-01652

HYDROGEN METABOLISM BY DECOMPOSING CYANOBACTERIAL AGGREGATES IN BIG SODA LAKE, NEVADA,
Geological Survey, Menlo Park, CA.
R. S. Oremland.
Applied and Environmental Microbiology, Vol. 45, No. 5, p 1519-1525, May, 1983. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Hydrogen metabolism, *Cyanobacteria, Cyanophyta, Bacteria, Nitrogen fixation, Fermentation, Metabolism, Decomposition, Anaerobic conditions, Big Soda Lake, Nevada.

Hydrogen production by incubated cyanobacterial epiphytes occurred only in the dark, was stimulated by C2H2, and was inhibited by O2. Addition of NO3(-) inhibited dark, anaerobic H2 production, whereas the addition of NH4(+) inhibited N2 fixation (C2H2 reduction) but not dark H2 production. Aerobically incubated cyanobacterial aggregates consumed H2, but light-incubated rates (3.6 micromol of H2/g/h) were statistically equivalent to dark uptake rates (4.8 micromol of H2/g/h), which were statistically equivalent to dark, anaerobic production rates (2.5 to 10 micromol of H2/g/h). Production rates of H2 were fourfold higher for aggregates in a more advanced stage of decomposition. Enrichment cultures of H2-producing fermentative bacteria were recovered from freshly harvested, H2-producing cyanobacterial aggregates. Hydrogen production in these cyanobacterial communities appears to be caused by the resident bacterial flora and not by the cyanobacteria. In situ areal estimates of dark H2 production by submerged epiphytes (6.8 micromol of H2/sq m/h) were much lower than rates of light-driven N2 fixation by the epiphytic cyanobacteria (310 micromol of C2H4/sq m/h). (Author's abstract)
W84-01653

MICROBIOLOGICAL SURVEY OF ADIRONDACK LAKES WITH VARIOUS PH VALUES,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W84-01654

INITIAL EFFECTS OF THE MOUNT ST. HELENS ERUPTION ON NITROGEN CYCLE AND RELATED CHEMICAL PROCESSES IN RYAN LAKE,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
C. N. Dahm, J. A. Baross, A. K. Ward, M. D. Lilley, and J. R. Sedell.
Applied and Environmental Microbiology, Vol. 45, No. 5, p 1633-1645, May, 1983. 10 Fig, 6 Tab, 48 Ref.

Descriptors: *Mount St. Helens, *Volcanoes, *Nitrogen cycle, *Lakes, Nutrients, Cyanobacteria, Bacteria, Nutrient cycling, Phosphorus, Sulfur, Manganese, Iron, Organic carbon, Ryan Lake.

Ryan Lake, a 1.6-hectare basin lake near the periphery of the tree blowdown area in the blast zone 19 km north of Mount St. Helens, was studied from August to October 1980 to determine the microbial and chemical response of the lake to the eruption. Nutrient enrichment through the addition of fresh volcanic material and the organic debris from the surrounding conifer forest stimulated intense microbial activity. Concentrations of such nutrients as phosphorus, sulfur, manganese, iron, and dissolved organic carbon were markedly elevated. Nitrogen cycle activity was especially important to the lake ecosystem in regulating biogeochemical cycling owing to the limiting abundance of nitrogen compounds. Nitrogen fixation, both aerobic and anaerobic, was active from aerobic benthic and planktonic cyanobacteria with rates up to 210 nmol of N2/cm/h and 667 nmol of N2/l/h, respectively, and from anaerobic bacteria with rates reaching 220 nmol of N2/l/h. Nitrification was limited to the aerobic epilimnion and littoral zones where rates were 43 and 261 nmol of NO2/l/day, respectively. Potential denitrification rates were as high as 30 micromol of N2O/l/d in the anaerobic hypolimnion. Total bacterial numbers ranged from 1 x 10 to the 6th to 3 x 10 to the 8th power/ml with the number of viable sulfur-metal-oxidizing bacteria reaching 2,000,000/ml in the hypolimnion. A general scenario for the microbial cycling of nitrogen, carbon, sulfur, and metals is presented for volcanically impacted lakes. The important role of nitrogen as these lakes recover from the cataclysmic eruption and proceed back towards their prior status as oligotrophic alpine lakes is emphasized. (Author's abstract)
W84-01657

ESTIMATING BACTERIOPLANKTON PRODUCTION BY MEASURING (3H)THYMIDINE INCORPORATION IN A EUTROPHIC SWEDISH LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
R. T. Bell, G. M. Ahlgren, and I. Ahlgren.
Applied and Environmental Microbiology, Vol. 45, No. 6, p 1709-1721, June, 1983. 2 Fig, 10 Tab, 77 Ref. Swedish National Science Research Council grant B-BU 3083-105.

Descriptors: *Bacteria, *Plankton, *Eutrophic lakes, *Thymidine, Primary productivity, Chrysophyta, Cyanophyta, Cyanobacteria, Biomass, Radioactive tracers, Carbon dioxide, Lake Norrviken, Sweden.

Bacterioplankton abundance, tritiated thymidine incorporation, carbon-14 labeled CO2 uptake in the dark, and fractionated primary production were measured on several occasions between June and August 1982 in eutrophic Lake Norrviken, Sweden. Bacterioplankton abundance and carbon biomass ranged from 0.5 x 10 to the 9th power to 2.4 x 10 to the 9th power cells/l and 7 to 47 micro g of C/l, respectively. The average bacterial cell volume was 0.185 cu micro m. Thymidine incorporation into cold-trichloroacetic acid-insoluble material ranged from 12 x 10 to the 12th power to 200 x 10 to the 12th power mol/l/h. Bacterial carbon production rates were estimated to be 0.2 to 7.1 micro g of C/l/h. Bacterial production estimates from thymidine incorporation and CO2 uptake in the dark agreed when activity was high but diverged when activity was low and when blue-green algae (cyanobacteria) dominated the phytoplankton. Size fractionation indicated negligible uptake of thymidine in the > 3 micro m fraction during a chrysophycean bloom in early June. More than 50% of the 3H activity was in the > 3 micro m fraction in late August; this phenomenon was most likely due to Microcystis spp., their as[s]ed bacteria, or both. Over 60% of the CO2 [u]in the dark was attributed to algae on each [sa]mpling occasion. Algal exudate was an imp[or]carbon source for planktonic bacteria. Ba[c]production was roughly 50% of primary pr[o]tion. (Moore-IVI)
W84-01658

COMPARISON OF DENITRIFICATION ESTIMATION TECHNIQUES IN A LA[R]SHALLOW LAKE,
Utah Water Research Lab., Logan.
J. Messer, and P. L. Brezonik.
Water Resources, Vol. 17, No. 6, p 631-640, [J]1983. 5 Fig, 5 Tab, 35 Ref.

Descriptors: *Denitrification, *Mass ba[l]*Bottle incubation, Model studies, Nitrates, C[ar]ic carbon, Suspended solids, Nitrogen input, [Flor]ida, Lake Okeechobee.

A comparison was made between various in[situ]tion techniques and a mass balance model fo[r] mating annual denitrification rates in Lake [O]chobee, Florida, a large, shallow lake. Incut[ation] techniques involving isolation of the sediment [with] nitrate and labile organic carbon sources tend[ed] produce low rate estimates, while diag[nostic] models based on nitrate profiles tended to pr[oduce] unrealistically high rate estimates. Each tech[nique] has inherent errors when used with frequ[ently] suspended sediments, but most incubation [tech]niques were in general agreement with mas[s bal]ance calculations. Denitrification rate esti[mates] range from 0.5 to 1.3 g N/sq m/yr, which r[epre]sents 9-23% of the average annual nitrogen i[nput] to the lake. (Author's abstract)
W84-01679

SURVEY OF STOCKING POLICIES FOR T[AIL]WATER TROUT FISHERIES IN THE SOU[THE]ERN UNITED STATES,
Fish and Wildlife Service, Bowling Green, [KY]. East Central Reservoir Investigations.
W. D. Swink.
Progressive Fish-Culturist, Vol. 45, No. 2, p [63]April, 1983. 3 Tab, 10 Ref.

Descriptors: *Trout, *Tailwater, *Fish stoc[king], Fisheries, Fingerlings, Fishing pressure.

A survey of the 16 southern states showed th[at] tailwaters in 13 states were stocked with tro[ut] 1980. Of the almost 3.7 million trout releas[ed] these waters, 81% were of catchable size and [79]were fingerlings (< 150mm). Tailwaters rec[eived] 32% of all trout stocked in the South; nearly [75]of the tailwater fish were rainbow trout (S[alm]gairdneri). A trend away from 'put-grow-and-[take]' fisheries toward 'put-and-take' fisheries was n[oted]. Limited creel data confirmed that fishing pre[ssure] in southern tailwaters was heavy, and that [>]90% of the trout stocked were recovered[by] anglers. (Author's abstract)
W84-01683

SENSITIVITY OF FLORIDA LAKES [TO] ACIDIC PRECIPITATION,
Florida Univ., Gainesville. School of Forest [Re]sources and Conservation.
D. E. Canfield, Jr.
Water Resources Research, Vol. 19, No. 3, p [834]839, June, 1983. 3 Fig, 4 Tab, 66 Ref. Dept. o[f the] Interior project 14-16-0009-79-064.

Descriptors: *Lakes, *Water chemistry, *Flo[rida], Hydrogen ion concentration, Alkalinity, Ca[lcium], Calcium, Hardness, Acid rain, Zooplankton, C[hlo]rophyll a, Lake fisheries.

To assess the potential vulnerability of Fl[orida] lakes to damage by acidic precipitation, data [from] a survey of 165 lakes located in the major ph[ysio]graphic and geologic regions of Florida were [used] to determine pH, total alkalinity, calcium hard[ness] and calcite saturation index values. Mean lak[e pH] ranged from 4.1 to 8.9. Mean total alkalinity [con]centrations ranged from 0 to 4100 ueq/l and r[anged]

ardness concentrations ranged from 20 to
/l. Total alkalinity averaged below 200
49% of the sampled lakes. Calcite satura-
values were greater than 4 in 36% of the
lakes. Based on these data, Florida has a
nber of lakes that are vulnerable to reduc-
pH and alkalinity by acidic precipitation.
chlorophyll a concentrations, zooplankton
e, and recent fisheries data, however,
at Florida lakes may not be as biological-
ve as the alkalinity and calcite saturation
ight suggest. Low phosphorus and nitro-
entrations are primarily responsible for
animal and plant populations in acidic
akes. Consequently, predictions of future
r trends based on current sensitivity indi-
ld be regarded with caution. (Author's

25

ter In Plants

OF SUMMER MOISTURE STRESS
E CAPACITY OF TANSY RAGWORT
O JACOBAEA) TO COMPENSATE
FOLIATION BY CINNABAR MOTH
JACOBAEAE),
State Univ., Corvallis. Dept. of Entomol-

, and P. B. McEvoy.
f Applied Ecology, Vol. 20, No. 1, p 225-
l, 1983. 3 Fig, 2 Tab, 20 Ref.

rs: *Moisture stress, *Defoliation, Mois-
ability, Ragwort, Rainfall, Weed control,
l control.

gwort plants were grown under different
regimes to assess the effect of summer
stress on their capacity to compensate for
n by larvae of the cinnabar moth. Three
of compensation capacity increased with
frequency of irrigation: the amount of
produced following defoliation, the
f nodes which produced this growth, and
er of flower heads (capitula) produced
defoliation. Thus moisture availability
ant compensation under these experimen-
ions. Compensation capacity was posi-
related with moisture availability in (a)
ns of populations at a high summer rain-
nd a low summer rainfall site and (b)
ns of populations during wet and dry
us moisture availability appeared to limit
pensation under natural as well as experi-
nditions. These results indicate that the
tial of the cinnabar moth as a biological
gent of tansy ragwort will be apparent in
n below average summer rainfall. In wet
introduction of additional biological con-
s should be considered. Investigation of
nces of abiotic conditions on the interac-
veen plants and their herbivores may be
in other studies concerned with predict-
utcome of this interaction. (Author's ab-

2

AS A FACTOR IN SALT DESERT
VEGETATION PATTERNS IN
VALLEY, UTAH,
st, and M. M. Caldwell.
Midland Naturalist, Vol. 109, No. 2, p
April, 1983. 1 Tab, 9 Ref.

rs: *Snow depths, *Desert plants, *Vege-
il water, Shrubs, Snowpack, Wind, Melt-
mation, Utah.

t differences in average snow depths - for
es in each of four winters - occurred at
ions each in pure Atriplex confertifolia
toides lanata stands and an intermediate
cies stand. The average depth of snow
er the season that the snow lasted was
ly different between community types in
he four winters investigated. Average
th in the Ceratoides type was less than in
plex and the mixed type. The difference
y related to variations in stature of the vegetation which modify snow deposition, redistribution by wind, melting and sublimation. The difference in snow depth corresponded with greater soil moisture recharge under the taller vegetation for 1 year for which data were available. Occasional differential snowpack development in these adjacent communities may influence vegetation boundaries in this area. (Author's abstract)
W84-01451

SIMULATION MODEL OF THE WATER BALANCE OF A CROPPED SOIL: SWATRE,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W84-01694

2J. Erosion and Sedimentation

SEDIMENTATION IN A LARGE LAKE: A REINTERPRETATION OF THE LATE PLEISTOCENE STRATIGRAPHY AT SCARBOROUGH BLUFFS, ONTARIO, CANADA,
Toronto Univ. (Ontario). Dept. of Geology.
C. H. Eyles, and N. Eyles.
Geology, Vol. 11, No. 3, p 146-152, March, 1983. 4 Fig, 37 Ref.

Descriptors: *Sedimentation, *Lakes, Glacial drift, Suspended sediments, Pleistocene, Canada.

A lithofacies code developed for diamicts emphasizes facies variability in the classic upper Pleistocene glaciogenic sequence at Scarborough Bluffs, Ontario, Canada. Lithological breaks along the bluffs are traditionally assigned to incursions of grounded ice margins and to interstadial lakes formed during ice retreat, during the Early and Middle Wisconsin. Detailed sedimentological logging through three diamict units (previously formalized as Sunnybrook, Seminary, and Meadowcliffe Tills) are intervening sandy lithofacies shows absence of glaciotectonic structures and diamicts associated with grounded glacier ice, traction-current activity during diamict accumulation, postdepositional resedimentation of diamicts into topographic lows accompanied by turbidite acitivity, a subaqueous deltaic origin for intervening sandy lithofacies, and loaded, transitional, and interbedded contacts between sand and diamict. The Scarborough Bluffs sequence may be the preserved bottom stratigraphy of a large lake. The bottom stratigraphy results from repeated basinward progradation of deltaic sandy lithofacies over glaciolacustrine diamicts deposted below floating ice, whether ice shelf, ramp, bergs, or lake ice. A facies model is presented by glaciolacustrine diamict deposition on the floors of enlarged Pleistocene lakes trapping substantial volumes of fine-grained suspended sediment. (Author's abstract)
W84-01444

REMODIFIED EINSTEIN PROCEDURE FOR SEDIMENT LOAD,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. W. Shen, and C. S. Hung.
Journal of Hydraulic Engineering, Vol. 109, No. 4, p 565-578, April, 1983. 5 Fig, 3 Tab, 7 Ref. ENG 7825054.

Descriptors: *Sediment transport, Suspended sediments, Flow, Sampling, River flow, Mathematical studies.

A procedure has been developed to calculate the total sediment transport rates from the flow and suspended sediment data collected from the sampled zone (by depth integrated sampler). This procedure is a modification of the well-known 'Modified Einstein Procedure.' The two major modifications are that (1) The z components in the Modified Einstein Procedure, based on the 0.7 power of the fall velocity, were replaced with a regression equation to be determined by actual field data; and (2) an optimization procedure with constraints was included to minimize the difference between the measured and calculated suspended sediment rates in the sampled zone. Using measured loads from large rivers, a comparison of suspended sediment loads calculated by the two methods indicates that this Remodified Einstein Procedure is superior to the Modified Einstein Procedure. Results from this study also indicate that sediment load in unsampled zone for larger rivers can exceed the measured sediment load in sampled zones. (Author's abstract)
W84-01536

THE HYDRAULICS OF RESERVOIR SEDIMENTATION,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
W. H. Graf.
International Water Power and Dam Construction, Vol. 35, No. 4, p 45-52, April, 1983. 12 Fig, 52 Ref.

Descriptors: *Reservoirs, *Sedimentation, *Hydraulics, Deposition, Mathematical studies, Deltas, Erosion, River flow.

Various theoretical approaches to the problem of reservoir sedimentation are considered along with empirical predictions of delta formation. Predicting the deposition pattern can only be done for conditions which simplify the model. If the geometry of the channel-reservoir system, the change in roughness, the non-uniformity of the sediment, the hydrograph of the watercourse, and the reservoir operation are all taken into account, a very complex model is obtained. Deltas are formed if the flow of the river diminishes in velocity and the coarse fractions of incoming sediments are deposited. Bottom sediment is formed downstream from deltas, when the finer fractions are deposited. Important criteria are the evaluation of the water surface profile, which will change once deposition occurs, and evaluation of the bottom (bed) profile which will alter as deposition progresses. For hydraulic calculations it is necessary to satisfy the continuity of water flow, continuity of sediment transport, and conservation of momentum of waterflow. It is also necessary to use a relationship for sediment transport (bedload and/or suspended load), and a relationship for flow resistance. In the Lehigh approach, the backwater profile is obtained in a river-reservoir system, without the sediment transport being considered, and then the deposition of the bedload is determined in successive short reaches along the system. This approach is rather simple, yielding the growth and the advancement of the delta formation, resembling the ones observed in a real situation. In the Grenoble approach the evolution of the longitudinal profile of a river and the transport of sediments on the river bed are simulated. The HEC approach is similar in point of view of hydraulics to the other approaches. The concept of the approach is such that continuous updating can and is done. Other methods include dimensional analysis, load distribution relationships, and comprehensive surveys of the mathematical techniques of solving the water and sediment equation. (Baker-IVI)
W84-01621

DISSOLVED IONS, STABLE AND RADIOACTIVE ISOTOPES AND NOBLE GASES IN THERMAL WATERS OF SOUTH AFRICA,
University of the Witwatersrand, Johannesburg (South Africa). Nuclear Physics Research Unit.
E. Mazor, and B. Th. Verhagen.
Journal of Hydrology, Vol. 63, No. 3-4, p 315-329, June, 1983. 3 Fig, 6 Tab, 22 Ref.

Descriptors: *Thermal springs, *South Africa, *Water chemistry, Isotopes, Groundwater recharge, Tritium, Neon, Argon, Krypton, Xenon, Water temperature, Helium, Geochemistry.

Sixteen thermal springs of South Africa were studied. Chemically, two salinity groups were found; one group at 3-13 meq/l TDI (total dissolved ions) issuing in crystalline terrains, and a more saline group, 30-80 meq/l TDI, mostly associated with sedimentary rocks. Stable hydrogen and oxygen isotopic compositions indicate direct recharge by heavy rains and negligible intermixing with water from adjacent rivers. Tritium concentrations are generally low. In a few cases, tritium at the limit of

detection, combined with sub-recent C14, might indicate some admixture of recent water. Dissolved Ne, Ar, Kr and Xe occur at atmospheric isotopic composition and at concentrations indicating intake temperatures of 15-35 degrees C. These intake temperatures show a clear dependence of climatic and geographical factors. Some of the springs contain significant amounts of radiogenic helium, accompanied by radiogenic argon. The (He4/Ar40) radiogenic values are in the range of 1-7, indicating common rocks as the origin rather than concentrates (ores) of U and Th. Low helium values in some of the thermal springs are explained by large flows and short residence times. (Author's abstract)
W84-01696

ONE-DIMENSIONAL BED WAVE MOVEMENT IN LOWLAND RIVERS,
Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
G. J. Weir.
Water Resources Research, Vol. 19, No. 3, p 627-631, June, 1983. 2 Tab, 22 Ref.

Descriptors: *Gravel, *Bed wave, *Sediment transport, Friction, Bed load, River beds, Wyoming, East Fork River.

Large quantities of gravel may translate down a river in the form of a bed wave. The central difficulties in formulating a one-dimensional gravel flow theory are the uncertainties in the transport laws for gravel and for water friction. Bed form translational speeds and the apparent changes in channel cross-sectional area are independent of water friction, but bed form evolution is water friction dependent. Recent measurements in the East Fork River, Wyoming, of annual gravel wave translation, annual bedload transport, and annual variations in riverbed cross-sectional area can be described to within a factor of 2 by using the Gradowczyk characteristic velocity for bed waves to describe gravel wave translation, the Engelund-Hansen formula for bedload transport, and a Du-Boyslike formula for changes in cross-sectional area. No free parameters are needed. (Moore-IVI)
W84-01705

VARIABILITY OF SEDIMENT REMOVAL IN A SEMIARID WATERSHED,
Arizona State Univ., Tempe. Dept. of Geography.
W. L. Graf.
Water Resources Research, Vol. 19, No. 3, p 643-652, June, 1983. 11 Fig, 1 Tab, 37 Ref. NSF grant EAR-7727698.

Descriptors: *Sediment erosion, *Semiarid lands, *Alluvium, Sediment transport, Channel morphology, Sediment storage, Stream order, Spatial distribution, Walnut Gulch Watershed, Arizona.

Field and documentary data from Walnut Gulch Watershed, an instrumented semiarid drainage basin of approximately 150 sq km (57 sq mi) in southeastern Arizona, show that 83% of the alluvium removed from the basin during a 15-year episode beginning about 1930 was excavated from the highest-order stream. The amount of alluvium removed in the erosion episode would have been equal to a covering of about 4 cm (1.6 in) over the entire basin. The rate of sediment removal during the erosion episode was 18 times greater than the rate of present channel sediment transport. Production of sediment from slopes and channel throughput as present rates are approximately equal, and refilling will not occur under present conditions. The channel forms left by the massive evacuation of sediment impose controls on the spatial distribution of tractive force and total stream power that make renewed storage of sediment likely in only a few restricted locations. Modern instrumented records of a decade or more provide an inadequate perspective on long-terms sediment movement. (Author's abstract)
W84-01707

PARTICULATE DYNAMICS, DISSOLVED AND TOTAL LOAD, IN TWO SMALL BASINS, NORTHERN PENNINES, UK,
Freshwater Biological Association, Ambleside (England).
P. A. Carling.
Hydrological Sciences Journal, Vol. 28, No. 3, p 355-375, September, 1983. 6 Fig, 5 Tab, 73 Ref.

Descriptors: *Suspended sediments, *Dissolved solids, Streamflow, Flashy streams, Cations, Precipitation, Storm runoff, Flow discharge, Hydrographs, Organic matter, Silt, Flood peak, Carl Beck, Great Eggleshope Beck, England.

Suspended sediment and dissolved load were measured in two upland piedmont gravel-bedded streams, Carl Beck and Great Eggleshope Beck, for one year. In addition, the input of major cations from precipitation and the cation content of springs within the basins were monitored. The dynamics of the suspended load through a series of storm flows were examined in relation to sediment supply and progressive exhaustion effects. In both Carl Beck and Great Eggleshope Beck suspended sediment concentration increased during storm periods with discharge. This increase was described by a second-order polynomial function with a tendency for the concentration to fall towards a constant suspended sediment concentration at baseflow of 3 mg/l. In each case, the load was an undercapacity load. The impact of sediment from collapsing stream banks, the variable timing of sediment concentration peaks in relation to the hydrograph peaks, and progressive sediment exhaustion effects reflect variable sediment supply. Nevertheless, in as much as storm discharge and concentration were correlated, hydraulic control of concentration level remained significant in these flashy streams. The organic concentration varied between 33 mg/l and less than 1 mg/l with an arithmetic mean of 4.8 mg/l. The concentration of the organic sediment increased as a power function of the total suspended sediment concentration. Most suspended inorganic material was coarse silt. Increases in mean grain size coincided with flood peaks when competancy was at a maximum and reflect the dominance of in-channel sediment sources. For Carl Beck, the total load for 1980 was calculated to be 135.38 t/sq km/year; for Great Eggleshope Beck, the total load was calculated to be 12.62 t/sq km/year. (Moore-IVI)
W84-01762

2K. Chemical Processes

SEASONAL VARIATION IN THE ACCUMULATION OF RADIONUCLIDES OF THE URANIUM SERIES BY YELLOW POND-LILY (NUPHAR LUTEA),
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
D. C. Mahon, and R. W. Mathewes.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 5, p 575-581, May, 1983. 1 Fig, 5 Tab, 11 Ref.

*Water analysis, *Radioisotopes, *Seasonal variations, Chemical composition, Plants, Macrophytes, Accumulation, Aquatic plants, Heavy metals, Uranium, Radon, Biological magnification.

The potential for bioconcentration of naturally occurring radionuclides was investigated in yellow pond-lily and possible seasonal variations were also considered. Water, plant and lake sediment samples were collected from an area of high natural radioactivity in the Okanagan Highlands of south-central British Columbia. The water chemistry of the seven sample sites during both spring and summer showed increases in the dissolved U-nat content in the spring. There may have also been a slight variation in the concentration of Po-210, but it was not verified statistically. Both Ra-226 and Pb-210 stayed effectively below the limits of detection. Radionuclide concentrations in the sediments from each location did not differ significantly by season, though there were small changes, probably due to changes in the water table, surface run-off patterns and degree of saturation of the soil in the environs of the ore body. In autumn there was no correlation between the surface water pH and dissolved U-nat, but a higher negative correlation between surface water pH and sediment burden of U-nat existed. The data indicate that as the pH
aquatransport of U-nat decreases U-nat ap
moves from the ore body in the spring
accumulated in the sediments during the
A significant seasonality was noted in the
lation of U-nat and Ra-226 by the aquatic
phyte Nuphar lutea. This suggests the me
of accumulation is independent of the
external factors associated with the accu
of heavy metal residues such as water co
tion or pH. The differences are thus prob
to changes in the physiological state of th
These data identify the critical natures
sample collection time in the investiga
heavy metal accumulation or transport in
systems. (Baker-IVI)
W84-01436

MEASUREMENT OF WEAK ORGANIC ITY IN PRECIPITATION FROM RE AREAS OF THE WORLD,
Virginia Univ., Charlottesville. Dept. of E
mental Sciences.
W. C. Keene, J. N. Galloway, and J. D. Ho
Jr.
Journal of Geophysical Research, Vol. 88,
p 5122-5130, June 20, 1983. 7 Fig, 5 Tab,

Descriptors: *Chemistry of precipitation,
Acid rain, Ions, Organic acid, Formic acid,
acid, Australia.

The Global Precipitation Chemistry Proje
lects precipitation by event to determine th
position of precipitation and processes that
it in five remote regions. Ion balances ba
major inorganic species revealed consisten
deficits at certain sites. This and other e
suggested that weak organic acids contribu
free acidity. Accurate and precise technique
developed to measure organic anions an
acidity in precipitation. Twelve samples
remote site were analyzed for major organ
inorganic chemical constituents. Formic and
acids were found in all aliquots which ha
treated with a biocide. The disappearance o
acids from untreated aliquots corresponde
proportionate decrease in free acidity. We
ganic acids contributed 64% of free acidi
63% of total acidity to precipitation during
the 1981-1982 wet season at Katherine, Au
Unmeasured proton donors contributed 2
total acidity during the period. (Author's ab
W84-01489

TEMPORAL DISTRIBUTIONS OF RA TRONTIUM ISOTOPES AND R DAUGHTERS IN RAINWATER DURI THUNDERSTORM,
L. A. Burchfield, J. D. Akridge, and P. K.
Kuroda.
Journal of Geophysical Research, Vol. 8
C13, p 8579-8584, October 20, 1983. 3 Fig,
18 Ref. ATM 78-19965.

Descriptors: *Rainwater, *Isotope studies,
tium, Lead, Polonium, Cesium, Thunders
Air masses, Arkansas.

The concentrations of Sr89, Sr90, Cs137,
Pb212, and Po210 were measured in seque
sampled rainwater during a thunderstorm
ring at Fayetteville, Arkansas, on January 29
Approximately concordant mean residence
ranging from 43 to 136 days were obtainec
the observed ratios of Sr89/Sr90 and F
Pb210. The Pb212/Pb210 ratio was found to
late negatively with the Po210/Pb210 ratio
variation of the Pb212/Pb210 ratio appea
have resulted from turbulent mixing of air m
and it increased sharply after the rainfall rea
peak value. (Author's abstract)
W84-01491

AQUEOUS GEOCHEMISTRY AND THE CHANGEABLE CATION COMPOSITIO GLAUCONITE IN THE AQUIA AQU MARYLAND,

cal Survey, Towson, MD.
apelle, and L. L. Knobel.
Water, Vol. 21, No. 3, p 343-352, May-83, 6 Fig, 1 Tab, 15 Ref.

ors: *Water chemistry, *Aquifers, water movement, Cation exchange, Calagnesium, Potassium, Sodium, Glauconite, issolved oxygen, Aquia aquifer, Maryland.

ion composition of water in the Aquia of southern Maryland changes systematithe direction of ground-water flow. In the nt parts of the aquifer, calcium is the t cation in solution. Between 10 and 20 mi dient, calcium and magnesium are domiween 20 and 35 mi downgradient, magnel potassium are dominant, and, beyond 40 ngradient, sodium is the most abundant solution. The exchangeable cation comof glauconite in the Aquia aquifer changes ically in the direction of flow in a manner o the changes in water chemistry. These ions are interpreted as evidence that cation reactions are processes that simultaalter water composition and glauconite ion along the flowpath. Exchange paramand n for glauconite in the Aquia aquifer ermined, and the exchange parameters for ction were tested by an indirect method. tios of exchangeable cations on glauconite culated from water chemistry data using ed K' and n values. The sum of exchangans on glauconite samples is significantly the outcrop area than downgradient. Corng to this, the concentration of dissolved l dissolved oxygen in Aquia water is high outcrop area and decreases downgradient. ern suggests that incongruent dissolution nite is an additional process that modifies e composition near the outcrop area but is rtant downgradient. (Moore-IVI)
55

EXATION ANALYSIS OF FRESH S BY EQUILIBRIUM DIAFILTRA-

al Survey of Canada, Ottawa (Ontario). Geophysics and Geochemistry Div.

esources, Vol. 17, No. 5, p 501-510, May, ig, 4 Tab, 32 Ref.

ors: *Ultrafiltration, *Metal complexes, Nickel, Cobalt, Iron, Manganese, Zinc, cation, Diafiltration, Hydrogen ion con-n, Organic compounds.

um ultrafiltration has been employed to e the extent of Cu, Ni, Co, Fe, Mn and Zn in oxic waters from mineralized terrains. ations of Cu, Ni and Co were determined nt organic fractions separated by various ultrafilters. Titrations of fresh water sam-metal ions were made, and 'free' metal ation measured by equilibrium diafiltraeriments were made at concentrations and hich metals and ligands occur in natural Conditional stability functions ranged from e 6.72nd power at pH 6.5 to 10 to the wer at pH 7.6 for Ni and 10 to the 8.85th pH 6.8 to 10 to the 6.97th at pH 7.6 for w metal concentrations (approximately 8 the -7 M) only one complexing class of portance for natural water environments rved. The order of metal complexing abilound to be Cu > Ni > Co > Zn > Mn showing a preference towards the higher anic fractions. (Author's abstract)
71

IGATION OF THE FOLIN-CIOCAL-HENOL REAGENT FOR THE DETER-ON OF POLYPHENOLIC SUB-S IN NATURAL WATERS,
er Biological Association, Ambleside).

esources, Vol. 17, No. 5, p 511-525, May, ig, 10 Tab, 43 Ref.

Descriptors: *Phenols, *Water analysis, *Natural waters, Tannin, Tannic acid, Fulvic acid, Tyrosine, Organic compounds, Iron hydroxide.

The methodology associated with the Folin-Ciocalteau phenol reagent was investigated and the performance characteristics of a method using sodium carbonate as the supporting medium were determined. Calibration curves using phenol, tannic acid, or L-tyrosine were linear up to at least 1000 micrograms/l. The limit of detection was 6 micrograms phenol/l and the relative standard deviation at 100 micrograms phenol/l was 5.2% and at 1000 micrograms phenol/l was 4.1%. The absorbances obtained with equal amounts of a range of potential standards showed variations when compared with that of phenol: phenol (100%). L-tyrosine (62%), oak gall tannin (58%), tannic acid (48%), chestnut tannin (26%), oak tannin (24%), fulvic acid (5%). The method was applicable to a wide range of monohydric and polyhydric phenolic substances and interferences from inorganic and non-phenolic organic compounds were examined. Interference would be expected above 30 micrograms S(2-)/l, 300 micrograms Mn(II)/l, or 400 micrograms SO3(2-)/l. Concentrations of iron > 2 mg/l as Fe(II) or Fe(III) formed the insoluble iron (III) hydroxide which increased the absorbance, but centrifugation could be used to remove this source of interference. Other potential sources of interference (e.g. reducing agents and certain metabolic products) would be expected to have a negligible effect in unpolluted waters. Methods using diazotized sulfanilic acid or 4-aminoantipyrine (4-AAP) were found to be inferior when applied to natural water samples. (Author's abstract)
W84-01672

CALCITE SUPERSATURATION AND PRECIPITATION KINETICS IN THE LOWER COLORADO RIVER, ALL-AMERICAN CANAL AND EAST HIGHLINE CANAL,
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Suarez.
Water Resources Research, Vol. 19, No. 3, p 653-661, June, 1983. 8 Fig, 20 Ref.

Descriptors: *Calcite, *Supersaturation, *Colorado River, Chemical precipitation, Return flows, Saline water, Calcium carbonate, Residence time, Suspended load, Algae, Seasonal variation, Diurnal distribution, Chemical kinetics, All-American Canal, East Highline Canal.

In situ pH determinations and analysis of major ions in solution indicated that the lower Colorado River is supersaturated with respect to calcite throughout the entire daily cycle, in both winter and summer. Although the ion activity product was 4 to 6 times greater than the calcite solubility product, there was no detectable precipitation. Chemical analyses of water samples taken along 350 km of the river and canals from Parker Dam to the Salton Sea also revealed no evidence of calcium carbonate precipitation despite the inflow of saline and highly supersaturated irrigation return flows. Laboratory kinetic studies indicated that calcite crystal growth rates with Colorado River water are about 30% of the rate for pure Ca-HCO3 waters and about 70% of that for synethic Colorado River water. Calcite precipitation by crystal growth in the river is limited by the combination of short residence times and unavailability of reactive calcite. Critical supersaturation levels necessary for heterogeneous nucleation do not occur; a high suspended load limits algal photosynthesis and thus prevents large decreases in daytime H2CO3 levels. (Author's abstract)
W84-01708

KINETIC ANALYSIS OF STRONTIUM AND POTASSIUM SORPTION ONTO SANDS AND GRAVELS IN A NATURAL CHANNEL,
Geological Survey, Menlo Park, CA.
K. E. Bencala, A. P. Jackman, V. C. Kennedy, R. J. Avanzino, and G. W. Zellweger.
Water Resources Research, Vol. 19, No. 3, p 725-731, June, 1983. 9 Fig, 2 Tab, 19 Ref.

Descriptors: *Sorption, *Mass transfer, *Strontium, *Kinetics, *Potassium, Sand, Gravel, Mathematical models, Particle size, Mountain streams, Uvas Creek, California.

A kinetic, first-order mass transfer model was used to describe the sorption of strontium onto sand-and gravel-sized streambed sediments. Rate parameters, empirically determined for strontium, allowed for the prediction of potassium sorption with moderate success. The model parameters varied significantly with particle size. The sorption data were collected during an experimental injection of several elements into Uvas Creek, a small mountain pool-and-riffle stream on the Eastern slope of the Santa Cruz Mountains in California. The processes simulated are expected to also occur in much larger high-gradient streams. The sorption process onto sand-and gravel-sized sediment was relatively slow compared to changes in the dissolved concentrations. Although the model is empirical, qualitative interpretations can be given to the physical significance of the model and their size-dependent trends. (Moore-IVI)
W84-01715

SIMULATION OF SOLUTE TRANSPORT IN A MOUNTAIN POOL-AND-RIFFLE STREAM WITH A KINETIC MASS TRANSFER MODEL FOR SORPTION,
Geological Survey, Menlo Park, CA.
K. E. Bencala.
Water Resources Research, Vol. 19, No. 3, p 732-738, June, 1983. 7 Fig, 2 Tab, 21 Ref.

Descriptors: *Solute transport, *Mass transfer, *Sorption, Simulation, Streambeds, Mathematical models, Strontium, Kinetics, Pools, Riffles, Mountain streams, Hydrodynamics.

In natural channels there are often long periods of low flow during which solutes have repeated opportunity for contact with relatively immobile bed materials. Such conditions can exist in very small pool-and-riffle mountain streams. If a solute can sorb onto bed materials, then both hydrodynamics and chemical processes control solute transport. A simulation of these processes is presented for a carefully controlled and intensively monitored strontium injection experiment. The numerical model couples nonreactive, transient storage with a kinetic mass transport model for sorption. The results are compared to both in-stream and on-sediment strontium measurements. In mountain streams the stream hydrology is complex and is governed by a wide variety of time and distance scales. The present simulations assist in interpreting the relative roles of hydrologic and sorptive kinetic processes, and indicate the practical limits of our process and parameter knowledge. The simulations are relatively insensitive to the details of the kinetic mechanisms and to the spatial variability of the stream parameters. (Author's abstract)
W84-01716

SUPPLY-BASED MODELS OF SUSPENDED SEDIMENT TRANSPORT IN STREAMS,
Oregon State Univ., Corvallis. Dept. of Forest Engineering.
J. VanSickle, and R. L. Beschta.
Water Resources Research, Vol. 19, No. 3, p 768-778, June, 1983. 9 Fig, 1 Tab, 29 Ref.

Descriptors: *Sediment transport, *Suspended sediments, *Mathematical models, Sediment storage, Streamflow, Storm runoff, Reservoir releases, Flynn Creek Watershed, Oregon, Electric Lake Reservoir, Utah.

Most of the uncertainty in empirical streamflow-sediment relationships can be attributed to changing supplies. The transport model utilizes a power function which was augmented with a variable S representing sediment storage in the channel system. The resulting supply-based model was calibrated to concentration and streamflow time series data from four storm events in Flynn Creek watershed, a small forested watershed in coastal Oregon. The model was calibrated to data from a controlled release from Electric Lake Reservoir in Utah, during which streamflow was held constant for an extended period. The supply-based model

followed observed concentration time series more accurately than did a transport model based on S alone. Performance of the supply-based model was further enhanced by distributing sediment supplies S among several compartments which were accessed at different levels of stream discharge. Both the single-compartment and distributed models demonstrate that a knowledge of sediment supplies can improve predictions of suspended sediment concentrations during storm runoff. (Moore-IVI)
W84-01720

2L. Estuaries

SEASONAL DIVERSITY, ABUNDANCE, AND DISTRIBUTION OF ICHTHYOPLANKTON IN TAMIAHUA LAGOON, WESTERN GULF OF MEXICO,
Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias del Mar y Limnologia.
C. Flores-Coto, F. Barba-Torres, and J. Sanchez-Robles.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 247-256, March, 1983. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Plankton, *Lagoons, *Fish, Larvae, Salinity, Water temperature, Seasonal variation, Species diversity, Tamiahua Lagoon, Mexico.

The ichthyoplanktonic community of Tamiahua Lagoon, Veracruz, Mexico, was studied throughout an annual cycle. Major concentrations of larvae occurred in the central portion of the lagoon, occasionally along the channels, but never at the inlets. The cycle of larva abundance was correlated with cycles of salinity and temperature. In spite of the greater number of species then, the spring and summer periods had low species diversity and evenness, due to the marked domination by larvae of Anchoa mitchilli. The number of larval fish species and individuals entering the lagoon from the adjacent offshore waters was minimal. The greatest portion of species diversity is generated within the lagoon itself. The community structure identified corresponds to the physically controlled type, as indicated by the poor diversity values obtained. (Author's abstract)
W84-01404

SPATIAL DISTRIBUTION PATTERNS OF PLANKTONIC FISH EGGS IN LOWER MOBILE BAY, ALABAMA,
University of South Alabama, Mobile. Dept. of Biology.
R. D. Marley.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 257-266, March, 1983. 8 Fig, 1 Tab, 26 Ref.

Descriptors: *Estuaries, *Fish eggs, *Spatial distribution, Salinity, River discharge, Spawning, Water circulation, Mobile Bay, Alabama.

A 12-month survey of planktonic fish eggs in lower Mobile Bay yielded 110 samples containing over 105 eggs. Fourteen taxa were represented, of which eight were abundant enough for analysis. By normal and inverse schemes of numerical classification, two distinct assemblages (station groups), coastal and estuarine, were found. The coastal assemblage was influenced by high-salinity tidal intrusions, whereas the estuarine assemblage was influenced by low-salinity estuarine water and river discharge. The spawning location of adult fish, circulation patterns, and salinity gradients (due to river discharge) were responsible for delineating the two assemblages. There also were two species associations (species groups). Eggs of Anchoa mitchilli, Sciaenidae, and Symphurus sp. were ubiquitous in both the estuarine and coastal assemblages. The eggs of Harengula jaguana, Anchoa hepsetus, Anchoa sp., Chloroscombrus chrysurus, and Trinectes maculatus were found predominantly in the coastal assemblage. Month-to-month differences in the spatial distribution of eggs reflected the magnitude of river discharge into the estuary. All fish eggs were confined to bottom waters during high river discharge, but were about equally divided between surface and bottom waters when river discharge was low. (Author's abstract)
W84-01405

THE EFFECT OF NITROGEN FERTILIZATION ON THE PRODUCTION OF HALOPHYTES IN AN INLAND SALT MARSH,
Ohio Univ., Athens. Dept. of Botany.
D. G. Loveland, and I. A. Ungar.
American Midland Naturalist, Vol. 109, No. 2, p 346-354, April, 1983. 5 Fig, 2 Tab, 31 Ref. DEB 79-27236.

Descriptors: *Salt marshes, *Nitrogen, *Marsh plants, Halophytes, Productivity, Nutrients, Fertilization, Ohio.

The effect of nitrogen fertilization on plant production, soil and plant nitrogen content, and species distribution in an Ohio salt marsh was analyzed. Seasonal measurements indicate that the three dominant species attained maximal production at different times during the growing season. Production of Salicornia europaea increased with nitrogen fertilization and it appears that reduced soil nitrogen concentrations may be responsible for the different growth forms of S. europaea found in this marsh. Shoot nitrogen concentrations of S. europaea were inversely related to the growth response to fertilization. High tissue nitrogen concentrations in Hordeum jubatum and Atriplex triangularis suggest that some factor other than nitrogen is limiting to these species. (Author's abstract)
W84-01450

EFFECTS OF PERMANENT FLOODING ON CAREX-EQUISETUM WETLANDS IN NORTHERN SWEDEN,
Sveriges Lantbruksuniversitet, Umea. Dept. of Wildlife Ecology.
K. Sjoberg, and K. Danell.
Aquatic Botany, Vol. 15, No. 3, p 275-286, March, 1983. 3 Fig, 4 Tab, 33 Ref.

Descriptors: *Wetlands, *Flooding, *Vegetation, Water depth, Wildlife habitats, Marsh management, Sweden.

The effect of flooding sites of former, periodically flooded water-meadows in northern Sweden was studied in two areas for two and three years, respectively. The vegetation consisted mainly of Equisetum fluviatile L., Carex rostrata Stokes, Carex aquatilis Wahlenb., Comarum palustre L., and Lysimachia thyrsiflora L. Increase in water depth caused a significant decrease in the species number. Carex rostrata, C. aquatilis and Lysimachia thyrsiflora were almost eliminated (although Carex aquatilis seemed to be somewhat more tolerant to the increased water depth). Equisetum fluviatile was unaffected, except for increase in shoot length, while the effect of flooding on Comarum palustre was intermediate. The practical application of flooding is discussed with regard to habitat management for waterfowl. (Author's abstract)
W84-01452

THE RESPONSE OF INTERSTITIAL AMMONIUM IN EELGRASS (ZOSTERA MARINA L.) BEDS TO ENVIRONMENTAL PERTURBATIONS,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
F. T. Short.
Journal of Experimental Marine Biology and Ecology, Vol. 68, No. 2, p 195-208, April, 1983. 7 Fig, 2 Tab, 26 Ref. OCR-74-13457A02, OCE-77-27050.

Descriptors: *Eelgrass, *Marine sediments, *Ammonium, Seagrasses, Nitrogen uptake, Scour, Substrates, Nutrients.

Natural and human-induced perturbations of eelgrass (Zostera marina L.) beds were used to examine the interaction between the sediment interstitial ammonium pool and nitrogen uptake by the plants. The perturbations included: a natural destruction of an eelgrass bed by ice damage (scouring), followed by recolonization by eelgrass; colonization of introduced foreign substratum by eelgras
removal; and sealing the sediment surface. Ee
colonization of unvegetated areas was acc
nied by a substantial decrease in the inter
ammonium pool over a 4-yr period. The ch
in interstitial ammonium and shoot density d
colonization support an already determined
tionship between shoot density and ammo
pool measurements. In field perturbation e
ments, removing eelgrass leaves and sealin
sediment surface altered the flux of ammo
from the interstitial ammonium pool, and re
in a rapid increase in interstitial ammonium
centrations. Measurements of ammonium acc
lation under the various perturbation cond
and a control permitted calculation of the sed
ammonium flux. These estimates include upta
eelgrass roots, regeneration in the root zone
diffusion from the sediments. Nitrogen limi
was observed in some eelgrass beds. (Moore
W84-01478

**A TWO-DIMENSIONAL NUMERICAL MO
OF ESTUARINE CIRCULATION US
CUBIC SPLINES,**
Ecole Polytechnique, Montreal (Quebec). De
Civil Engineering.
P. Wang, and R. Kahawita.
Canadian Journal of Civil Engineering, Vo
No. 1, p 116-124, March, 1983. 9 Fig, 11

Descriptors: *Estuaries, *Mathematical mo
*Water circulation, Velocity, Salinity, Simul
Density stratification, Tidal effects, Hydr
models, Cubic splines, Great Whale Bay.

A two-dimensional, laterally integrated, num
model has been developed to represent the v
ity and salinity distribution along an estuary.
governing equations, which express the cons
tion of mass, momentum, and salt or heat co
are solved by a finite difference method in co
nation with spline functions. The model has
applied to the estuary of the Great Whale Riv
the James Bay region and results of the simul
are presented and compared with tide gauge
The sensitivity of the model to various valu
the stratification parameters that influence ve
diffusion has been studied and some prelim
results presented. The use of the cubic spline
mulation in computational hydraulics has
found to be promising and warrants further d
opment. (Author's abstract)
W84-01510

**THE HYDROGRAPHY AND PHYTOPLA
TON ECOLOGY OF LOCH ARDBHAI
SMALL SEA-LOCH ON THE WEST COAS
SCOTLAND,**
Dunstaffnage Marine Research Lab., Oban (
land).
R. J. Gowen, P. Tett, and K. J. Jones.
Journal of Experimental, Marine Biology
Ecology, Vol. 71, No. 1, p 1-16, August, 19
Fig, 7 Tab, 30 Ref.

Descriptors: *Lochs, *Tidal exchange, *Ph
plankton, *Hydrography, Eutrophication, Sea
variation, Chlorophyll, Dinoflagellates, Diat
Flagellates, Species composition, Biomass,
farming, Estuarine environment, Loch Ardb
Eddrachillis Bay, Scotland.

Loch Ardbhair was studied between January
and July 1982. Tidal exchange was the dom
hydrographic feature of the loch and the exch
time was estimated to be between 1 and 2 day
1981 seasonal changes in phytoplankton bio
and species succession were similar to other
lochs, although the spring peak, and summer l
of, phytoplankton biomass (3.0 and 1.0 mg ch
phyll/cu m respectively) were lower than m
have been predicted from winter levels of ni
Chlorophyll levels in Ardbhair were much hi
in July 1982 (up to 3.5 mg/cu m) compared to
1981 (0.7 mg/cu m) and the phytoplankton
dominated by dinoflagellates rather than micr
gellates and diatoms. Rapid exchange may lim
situ growth of phytoplankton in Ardbhair. Ph
plankton biomass and species composition in A

sely resembles that of Eddrachillis Bay ich the loch exchanges. Because of rapid e, phytoplankton blooms are unlikely to within such lochs. Lochs whose source rives from frontal regions could be at risk ooms of phytoplankton which might be to farmed fish. (Moore-IVI)
43

CTERISTICS OF ESCHERICHIA COLI IN BAY WATER AS COMPARED ICH MEDIUM,
d Univ., Cambridge. Center for Environnd Estuarine Studies.
i.
and Environmental Microbiology, Vol. , p 1316-1323, April, 1983. 2 Fig, 7 Tab,

ors: *Escherichia coli, *Bay water, Bactemicrobial agents, Heavy metals, Bacteriolicins, Detergents, Growth medium.

e-filtered bay water can support a certain f growth of Escherichia coli organisms rom the bay water or from sewage. The the growth medium (bay water versus ium) on sensitivities to antimicrobial d cell envelope proteins was studied in hese strains. Bay water-grown cells were tive to bacteriophages and colicins, but re sensitive to heavy metals and detercompared with rich-medium-grown cells. ults indicated that the cell envelope comof the bay water-grown cells could be resulting in altered susceptibility to varnicrobial agents. An analysis of cell enveins by sodium dodecyl sulfate-polyarylaelectrophoresis revealed that cells from um-grown cultures contained two or or outer membrane proteins, whereas in r-grown cells, the OmpF protein was duced. (Author's abstract)
9

TER SUPPLY MENTATION CONSERVATION

ter Yield Improvement

NG THE FLOW OF SOVIET RIVERS.
al Water Power and Dam Construction, o. 5, p 53-57, May, 1983. 4 Fig, 49 Ref.

s: *Water resources development, pply development, *Reservoirs, Water Water demand, Rivers, Environmental SSR, Onega River, Sukhona River, Lake ybinsk Reservoir, Volga River, Tobol ysh River, Novosibirsk Reservoir, Ob ylym River, Tom River.

are being considered in the Soviet Union rring waters from northward flowing the south. Territorial redistribution of urces in the USSR has become a matter policy. One of the two major plans idered calls for diversion of waters from na and Onega rivers and Lake Onega lso from Lakes Lacha and Vozhe) into sk reservoir and then to the upper the Volga. About 31 cu km a year withdrawn by 1990. Later stages of the age additional withdrawals variously Severnaya Dvina, Vychegda, Pinega, Yug as well as from the basin of Lake he second plan differs primarily in the probable impact on the environment. an would involve drawing water from a be built at the confluence of the Tobol and lifting it about 75 m, passing it e Turgay Gate into Kazakhstan, after ould flow by gravity towards the Aral he second stage, water would be drawn rvoir in the Khanty-Mansiysk area and ed either by a special canal or along the Irtysh. In the second variant the main is that in the first stage use would be made of the existing Novosibirsk reservoir on the Ob, and it would involve transferring the water by a canal starting at Kamen-on-Ob which would cross the Kulunda Steppe to a proposed reservoir on the Irtysh above Pavlodar, then by canal to Kurgan and on south. The second stage envisages drawing water from the Chulym and Tom rivers, transferring it to a reservoir to be built on the Irtysh and then on to Kurgan. Yet a third plan combined features from the other two, withdrawing water from the Novosibirsk reservoir and the Irtysh and Tobol in the first stage, and from the Chulym and Tom in addition to these in the second stage. Other water transport projects include the Irtysh-Karaganda canal, the Ob-Kulunda canal and the Volga-Ural canal. Impacts on the environment include changes in the levels of the Caspian and Aral Seas. (Baker-IVI)
W84-01622

FOUND WATER AT 200 GALLONS/YARD.
American City and County, Vol. 98, No. 8, p 58-59, August, 1983. 3 Fig.

Descriptors: *Dredging, *Reservoirs, *Sludge lagoons, Portsmouth, Virginia, Lake Meade, Water storage, Sediments, Dredging.

A 4.0 billion gallon impoundment system serves about 120,000 people in Portsmouth and parts of Suffolk and Chesapeake, Virginia. Daming of the Nansemond River in the later 1950s to form Lake Meade blocked the natural dispersion of sedimentation from the water treatment plant. Sludge began to collect in the Lake, gradually reducing its useful capacity. Several methods for removing the sludge were contemplated. The method chosen called for use of a shallow-draft dredge moved by conventional over-the-road flatbed trailer. Removal rates ranged up to 2,000 GPM and up to 120 cu yd/hr during the dredging operation. The slurry flowed by gravity to the 250,000 gallon holding tank until it could be pumped to the city's sludge treatment lagoon. Dredging operations continued for 10 hours a day, six days a week. In 80 calendar days the work was completed. Over 30,000 cu yd of material had been removed. For every yard of material removed, 200 gallons of water capacity were gained. (Baker-IVI)
W84-01669

RAINWATER INFILTRATION INTO A BARE LOAMY SAND,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2G.
W84-01765

3C. Use Of Water Of Impaired Quality

WATER REUSE IN WATER SURPLUS ENVIRONMENT,
Memphis State Univ., TN.
J. W. Smith, and C. Ritter.
Journal of Water Resources Planning and Management, Vol. 109, No. 3, p 223-235, July, 1983. 7 Fig, 8 Tab, 2 Ref.

Descriptors: *Water reuse, *Water substitution, Cost analysis, Computers, Industrial water, Water use, Water allocation.

Water reuse or substitution for high quality water in a water surplus area can be economical and a long-term protection against shortages and land subsidence. Cost optimization using computer assisted analysis of use allocation between users ('sinks') and supply ('sources') demonstrated a viable analysis procedure as well as the potential for water substitution. Secondary water use by industry is more attractive in an urban environment than irrigation or ground water recharge and may best be suited for industrial parks or complexes where a dual system (process and domestic) can be installed. (Author's abstract)
W84-01463

Conservation In Industry—Group 3E

RECLAMATION OF WASTEWATER CONSTITUENTS BY ION EXCHANGE; PART I REVIEW OF FLOWSHEETS FOR THE PROCESSES - CONTINUED FROM VOLUME 23 NUMBERS 1, 2 AND 4,
For primary bibliographic entry see Field 5D.
W84-01572

WASTEWATER REUSE AND RECYCLE IN PETROLEUM REFINERIES,
JRB Associates, Inc., Paramus, NJ.
B. S. Langer.
Chemical Engineering Progress, Vol. 79, No. 5, p 67-76, May, 1983. 1 Fig, 9 Tab.

Descriptors: *Water reuse, *Wastewater treatment, Reclaimed water, Petroleum industry, Wastewater renovation, Water use, Water supply development, Industrial wastes, Cooling towers.

Wastewater reuse and recycling techniques were studied at 15 petroleum refineries. Three of the refineries were selected for their exemplary reuse and recycle techniques, and the technologies used were investigated for their applicability at the remaining 12 facilities. Feasible reuse and recycle techniques were identified to reduce wastewater discharge and estimates of the associated costs were considered. Boiler feed waters involve large volumes of water, of which an estimated 37% is lost to the sewer in various forms, such as clean and scour condensate, boiler blowdown, and pretreatment wastes such as filter backwash, clarifier sludge, and softening regenerant. Steam condensate and vent loss elimination are also areas for considerable savings. Condensate recovery is the most economically attractive reduction technique studied. At refineries using cooling towers, the cooling tower blowdown streams amounted to one-third of the total refinery process wastewaters. Some refineries rely on air cooling to supply 20 to 40% of their cooling needs by Btu. Most refineries tend to pay insufficient attention to cooling water systems management. Some modifications which may be commonly applied include recycling cooling water from pumps, compressors and sample boxes that use blowdown; replacing existing oil-leaking pump gland packing with mechanical seals to permit collection and recycle of blowdown to cooling tower; reducing use of pump gland cooling water where pressure overused or eliminate service completely; and upgrade maintenance of existing systems to reduce leakage and sump overflow. Of the 12 refineries studied, potential areas for additional reuse of treated effluent were found at eight, for which possible flow reduction alternatives were identified. An average of 45% of the total process generated wastewaters could be reused for various purposes after end-of-pipe treatment at ten of the twelve refineries. (Baker-IVI)
W84-01664

IMPROVED EVAPORATORS FOR RADIOACTIVE WASTES,
Graver Co., Union, NJ. Unitech Div.
For primary bibliographic entry see Field 5D.
W84-01665

3E. Conservation In Industry

WATER CONSERVATION AND REUSE AT COAL-FIRED POWER PLANTS,
Burns and McDonnell, Kansas City, MO.
F. L. Shorney.
Journal of Water Resources Planning and Management, Vol. 109, No. 4, p 345-359, October, 1983. 2 Fig, 8 Tab, 2 Ref.

Descriptors: *Water conservation, *Water reuse, Power plants, Cooling water, Wastewater renovation, Wastewater treatment, Water requirements, Water treatment, Wastewater disposal.

Water conservation and reuse concepts which have been used at several major power plants (200 MW or larger) in the southwest, southeast, west, and mid-west United States are described. These plants typically employ wet-type cooling towers and most use wet-type, closed-loop sulfur dioxide

absorbers. All plants have limited discharge or zero liquid discharge site requirements. Basic concepts include the on-site storage of raw water and wastewater for operating flexibility, the treatment of raw water to optimize water use, water conservation in mechanical systems to minimize blowdown or waste streams, direct wastewater reuse and indirect reuse with wastewater treatment to reduce raw water requirements and site discharges, and water management to control the overall plant water balance. (Author's abstract)
W84-01470

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EFFECTS OF PESTICIDES ON PURE AND MIXED SPECIES CULTURES OF SALT MARSH POOL ALGAE,
Northeastern Univ., Boston, MA. Dept. of Biology.
M. Maly, and E. Ruber.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 1, p 464-472, April, 1983. 6 Tab, 9 Ref. RR07143.

*Algal growth, *Pesticides, Carbaryl, Salt marshes, Tidal marshes, Marshes, Diatoms, Chlorophyta, Dinoflagellates, Water pollution effects.

The general sensitivity of three diatom species, Nitzchia closterium, Amphora coffeaformis v. borealis, and Amphiprora sp.; green alga, Chlorococcum sp.; and a dinoflagellate, Gonyzulax sp., to five pesticides (temephos, propoxur, chlorpyrifos, malathion, and carbaryl) was investigated. Carbaryl was the most generally toxic of the five insecticides tested, and was used for further studies. Amphiprora was the most broadly sensitive alga followed by Chlorococcum. Gonyaulax, resistant to a concentration of 10 ppm, was the least affected of the species. Amphiprora had lowered growth with concentrations of 10, 21 and 1 ppm, but the effect on growth lasted only 4 hr with 2 and 1 ppm. Amphora was slightly more sensitive than the other species with growth depressed by 10, 2, and 1 ppm and this effect persisted through the entire 96 hr test period. Growth of Chlorococcum was depressed for 96 hr at 10, 2, and 1 ppm of carbaryl. In comparing results from single to multispecies cultures experiments, it becomes apparent that one cannot predict the effect of carbaryl on components of multispecies cultures solely from its effects in single-species cultures. All four species are inhibited by carbaryl at 2 ppm in single-species culture but in multispecies cultures only two are inhibited. Also, the rank order of species sensitivity differs between the two experimental designs. Amphiprora is more sensitive in the multispecies communities and Chlorococcum in single species cultures. Similarly, results after 2 and 4 day tests are not necessarily good indicators of longer term outcomes. (Baker-IVI)
W84-01429

RESERVOIR OPERATION BY LINEAR AND DYNAMIC PROGRAMMING,
California Univ., Davis.
M. A. Marino, and B. Mohammadi.
Journal of Water Resources Planning and Management, Vol. 109, No. 4, p 303-319, October, 1983. 6 Fig, 4 Tab, 14 Ref. CAD-LAW-4116-H.

Descriptors: *Reservoir operation, *Computers, Water demand, Flow, Forecasting, Computer models, Mathematical models.

The operation of reservoirs often requires frequent updating of the results of the operation model. This is mainly because of errors involved in forecasting the natural inflows to the reservoirs or demands for water and energy or both. Current models used for operation usually require the use of large computers because of their core-storage and computation-time requirements. Frequent use of such models for the purpose of updating will often result in high computation cost and usually involves long turnaround times. An efficient algorithm is presented for the monthly operation of a system of two parallel multipurpose reservoirs that is solved with a minicomputer. The operation model is applied to Shasta and Folsom reservoirs of the California Central Valley Project. The formulation of the mathematical model itself allows for optimization of both municipal and industrial water and energy. While the addition of other objectives will increase the size of the dynamic programming, and will require more core storage, the addition of more reservoirs will not affect the dynamic programming but causes the linear programming size to increase linearly. (Moore-IVI)
W84-01467

TUNISIA'S BOURGUIBA DAM AIDS REGIONAL DEVELOPMENT.
International Water Power and Dam Construction, Vol. 35, No. 8, p 30-32, August, 1983. 3 Fig.

Descriptors: *Water resources development, *Dam construction, Tunisia, Bourguiba Dam, Environmental effects, Sidi Saad project, Saddle dam, Irrigation, Spillways.

The Bourguiba Dam in Tunisia was built at Sidi Saad on the Zeroud wadi to control the flash floods that have threatened the regions's central plain and the city of Kairouan. The water in the reservoir will recharge water tables and irrigate 4000 ha of land. The Zeroud wadi drains a basin of 8572 sq km that encompasses the southeastern slopes of the Dorsale range and the eastern tip of the Atlas range. The Merguellil wade drains a basin of 1140 sq km and flows directly to Kairouan across the central plain. The Sidi Saad project began in 1976. In 1980 Tunisia began a reforestation scheme which will continue for 15 years. The central element of the Sidi Saad project is a main dam, 70 m high and 560 m long, with its crest at elevation 302.5, built at the narrowest part of the Zeroud gorge 2 km upstream from the point where the wadi enters the plain. It is an earthfill dam with an impervious clay core, and with its upstream and downstream coffer dams, called for 4,438,000 cu m of fill material. The shells are made up mainly of silts and clays and the transition and filter zones of granular materials. A 100 m band of clay marl on the left bank extends into the river bed and reappears on the right bank, so the core material was placed downstream of it, and a grout curtain, reaching as deep as 100 m in places was injected into the foundation to make sure that the marl would remain impervious and that no water could seep under the dam. A saddle dam, 48 m high and 520 m long with its crest at elevation 302.5 closes the gorge on the right bank. An open concrete spillway with a capacity of 6900 cu m/sec is built in an 80 m deep cut through the right bank mountain between the two dams. The two dams create a reservoir with a capacity of 1,994,000 cu m. A desilting system, integrated with the temporary diversion tunnel, is working well and efficiently on the density current principle. (Baker-IVI)
W84-01634

WHY NOT CHARGE FOR STORM DRAINAGE,
P. Gallagher, and D. Laredo.
American City and County, Vol. 98, No. 5, p 45-46, May, 1983.

Descriptors: *Runoff, *Storm runoff, *Drainage, Storm drains, Storm wastewater, Land development.

Stormwater runoff is often increased due to residential and industrial land development. Local governments often try to deal with these problems through traditional methods of stormwater drainage facilities using ad valorem property tax funds. Tight municipal budgets are causing some communities to consider financing stormwater drainage systems through user charges and developer contributions. This necessitates viewing the stormwater drainage as a utility. Users of a drainage system are the properties adding stormwater runoff, while the beneficiaries are the properties protected from flooding. Users of storm drainage systems have a legal duty, although not as clearly recognized as the duty to p wastewater treatment. The duty of land dev and property owners generally is to protect stream properties from higher than natural rates. A fiscally independent drainage utility ates both capital and operating funds from other than property taxes. A comprehensive by-basin drainage plan should be prepared to near-term and long-term drainage system im ments. The master drainage plan should enco not only the drainage basins within the loca ernment's jurisdiction, but also basins or p of basins that are outside the jurisdiction but drainage requirements within it. One prima vantage of utility-type financing, as oppo traditional methods of financing, is the crea a new revenue stream. Another advantage equity of recovering the costs of the service those who use it. (Baker-IVI)
W84-01667

FOR A RELIABLE WATER SUPPLY, COMES SECOND.
American City and County, Vol. 98, No. 7, 29, July, 1983. 3 Fig.

Descriptors: *Water supply development, lines, *Water conveyance, Drought, New M Raton, Water shortage, Economic aspects.

The town of Raton, New Mexico is situated high plains country in the northeast section state. The residents number about 8500 a water shortage has been acute with droughts only reemphasizing the problem. sources of additional water were cited in major improvements to the T. O. Dam, a impoundment on the Una de Gato Creek, ab mi southeast of Raton; a series of wells Capulin Basin some 26 mi southeast of the c a pipeline from the Cimarron River, 47 mi west of Raton. The last alternative was th chosen as best. The system, as proposed, v capable of supplying Raton with 2.5 MGD quate for a population of 13,000 or more. It with a new 2.5 million gallon reservoir existing water treatment plant. Upstream raw water reservoir are three pumping st each with its own 115,000 gallon bolted-steel voir. All four reservoirs and the pretreatment ities are connected by a microcomputer UHF-radio system. The reservoir at the fir tion is filled by gravity flow from the div and pretreatment facilities 20 mi distant. If w needed, it is released from Eagle Nest Lak the Cimarron River. From the diversion str on the river, a passive surface-water intake kept submerged by an automatic gate, water through a 2000-ft pipeline to the pretreatme cility. There it flows through a flocculato clarifier basin equipped with tube settlers, remove normal amounts of turbidity. If turbi above present limits, polymers are automa added to increase removal rates. (Baker-IVI)
W84-01668

RESERVOIR MANAGEMENT: A RELI ITY PROGRAMMING APPROACH,
California Univ., Davis. Dept. of Land, A Water Resources.
M. A. Marino, and B. Mahammadi.
Water Resources Research, Vol. 19, No. 3, 620, June, 1983. 3 Fig, 3 Tab, 20 Ref. O project A-088-CAL, WRC project UCAL-W-617.

Descriptors: *Reservoir operation, *Reservo leases, *Computer programs, Flood prote Drought, Reliability, Multipurpose rese Linear programming, Dynamic programming sonal variation, California Central Valley P Folsom Reservoir.

A reliability programming model is develop determine the optimum monthly releases f multipurpose reservoir. The model is base chance-constrained linear programming (C and dynamic programming (DP). The floo

t reliabilities are represented in the CCLP form of chance constraints. These reliabili- varied parametrically from their minimum d levels to their maximum possible values. ade-offs between flood and drought reliabili- made using a forward two-dimensional DP . The model does not require equal flood drought reliabilities during the year. reservoir of the California Central Valley is modeled to demonstrate the use of this ty programming approach. The resulting on policy shows high reliabilities of flood ought during winter and summer months, ively. The variable risk levels avoid unnec- releases during summer (for flood protec- nd unnecessary storage of water during (for drought protection). (Author's ab-

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Groundwater Management

ND-WATER MANAGEMENT IN ARIZO-

Dept. of Water Resources, Phoenix.
iggs
of Water Resources Planning and Manage- ol. 109, No. 3, p 195-202, July, 1983. 4 Fig,

tors: *Groundwater management, *Legal *Arizona, Overdraft, Water rights, Safe ater conservation, Economic aspects.

, which has had a long history of ground verdraft, has recently adopted a Ground Code that is designed to not only restrict trol withdrawals and uses of ground water, to reduce rates of overdraft over time to fe yield conditions in three major manage- eas by the year 2025. The Code provides nd water management by: (1) creating a of rights for existing users, allowing the nce and transfer of rights to new users to e changing nature of the state's economy nitting new rights to be issued only if the wals will not excerbate the overdraft prob- mandating all users to implement ever- ingent conservation measures that will be in a series of management plans; (3) pro- or purchase and retirement of irrigated ral lands and rights; and (4) providing for ation and recharge projects. Implementa- ne Code is proceeding; although statutorily d programs have been completed on time, ode's restrictions become more binding on s, resistance among them is increasing. s abstract)
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NA'S WATER STRATEGY: BRING N AND RESTRICT ITS USE,

nary bibliographic entry see Field 6D.
79

ffects On Water Of 's Non-Water ivities

LOGIC EFFECTS OF CLEARCUTTING WILDFIRE ON STEEP GRANITIC IN IDAHO,

ntain Forest and Range Experiment Sta- e, ID.
egahan.
esources Research, Vol. 19, No. 3, p 811- , 1983. 9 Fig, 3 Tab, 23 Ref.

ors: *Clear-cutting, *Wildfire, *Hydrolog- ties, *Slopes, Logging, Inflow, Outflow, orage, Snowmelt, Evapotranspiration, Soil rosion, Roads, Storm seepage, Intercep- nnel erosion, Granite, Idaho.

the environmental impacts of logging and are caused by changes in the hydrologic of slopes after disturbances. This study ducted to evaluate changes in inflow, stor- age, and outflow for 3-year periods before and after clearcut logging and wildfire on two steep, granitic microwatersheds in Idaho. Clearcutting alone and clearcutting plus wildfire increased annual peak snow water equivalent and snowmelt rates an average of 41% and 30%, respectively. The greater volume and rate of snowmelt caused respective increases in the peak piezometric rise and in total piezometric storage, amounting to 47% and 27%. Accordingly, the total volume of subsurface flow intercepted by the roadcut was increased 96% and was accompanied by 27% greater peak flow rates. None of the above responses were detectable on an adjacent watershed that was burned by wildfire alone. Evapotranspiration was reduced on both watersheds after clearcutting or wildfire, as indicated by increases in the unsaturated soil water content at the end of the growing season amounting to 44 and 72% respectively. Accelerated mass erosion on clearcut slopes, and accelerated surface and mass erosion on roads and in channels below roads, can result from such changes. (Author's abstract)
W84-01723

DESIGN OF CUT SLOPES IN OVERCONSOLIDATED CLAYS,

For primary bibliographic entry see Field 8D.
W84-01758

4D. Watershed Protection

SOIL EROSION: ECONOMIC AND TECHNOLOGICAL INTERFACES,

Department of Agriculture, Washington, DC.
G. S. Bridge.
Agricultural Engineering, Vol. 64, No. 8, p 13-16, August, 1983. 1 Fig, 2 Tab.

Descriptors: *Soil erosion, *Water conservation, *Regulations, Federal jurisdiction, Policy making, State jurisdiction.

Agriculture is the nation's biggest water user, accounting for about 50% of total freshwater withdrawals and over 80% of total consumption. While most of the country has enough surface water to meet demands most years, the High Plains area experiences the most extensive chronic water shortages. This is significant as considerable amounts of groundwater are being withdrawn for irrigation and other uses. In the High Plains, the increased cost of pumping water from greater depths is forcing many farmers to stop irrigating. Water pollution affects, to some degree, 95% of all US drainage basins. Non-point source pollution from agricultural lands is a major contributor to this problem. The USDA has developed a set of policies, priorities and initiatives to guide federal assistance activities for the next several years. Local and state governments will be encouraged to become full partners in developing and implementing conservation programs. (Baker-IVI)
W84-01611

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

AN IMPROVEMENT FOR THE CONCENTRATION OF MICROPOLLUTANTS IN THE MARINE ENVIRONMENT BY USING A BACTERIA STRAIN WITH A MEMBRANE FILTER SYSTEM,

System Science Consultants, Inc., Tokyo (Japan).
I. Allahpichay, M. Mishima, and T. Yoshida.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 3, p 253-260, March 1983. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Pollutant identification, Bacteria, Membrane filters, Filters, Marine environment, Biological magnification, DDT, Polychlorinated biphenyls.

Attempts were made to concentrate PCBs and DDT residues by a strain of bacteria and then to filter out the bacteria on a millipore filter using the model apparatus designed for this study. A Pseudomonas sp. was chosen as it represents one of the most dominant forms in the aquatic system. The selected strain demonstrated a bioconcentration ability in the range of 40-50% for PCBs and p,p-DDT in 3 hr exposures and attaining 80% for 12 hour exposures. The PCBs and DDT residues were not fully solubilized in the filtered seawater in spite of overnight stirring. The biofilter showed better recoveries than a membrane filter. There is a potential for PCBs and DDT residues in traces to be pre-concentrated using membrane filter and bacteria. Persistent pollutants adsorbed on to suspended particulates could be identified and quantified. Water samples assayed by this method showed traces of PCBs and p,p-DDE at concentrations sufficiently low that they were sensitive to the analytical method but could not be quantified, especially the PCBs. In trials of Tokyo Bay coastal waters, the p,-p-DDE adsorbed by the membrane filter-suspended particulates and the biofilter could be detected. This method could be used for evaluating the quality of water where PCBs and DDT residues could be present in concentrations below those toxic to aquatic life. (Baker-IVI)
W84-01418

DETECTION LIMITS OF A BIOLOGICAL MONITORING SYSTEM FOR CHEMICAL WATER POLLUTION BASED ON MUSSEL ACTIVITY,

Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
W. Slooff, D. de Zwart, and J. M. Marquenie.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 1, p 400-405, April, 1983. 3 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Monitoring, *Mussels, Mollusks, Organic compounds, Copper, Sulfates, Cadmium, Phenols, Cyanide, Industrial wastes.

An automatic early warning system for chemical water pollution is presented based on the valve response of the fresh water mussel, Dreissena polymorpha. To detect the behavior of mussels in terms of shell valve movements an electronic device was used. In this device one valve is fixed whereas the other valve transfers its action to a coil moving in an oscillating electromagnetic field generated by a fixed coil. The current in the receiving coil is subsequently converted to a voltage proportional to the valve displacement. The following chemicals resulted in a valve closure response: copper (sulfate), trichloroethylene, gamma-hexachlorocyclohexane, pentachlorophenol, hexachlorobutadiene, chloroform, ephnol, xylene, and cadmium (chloride). Although the biomonitor is probably somewhat less sensitive to toxicants than the system based on fish respiration, the mussel system is less susceptible to noise problems that may result in false alarms at an unacceptable rate. Changes in temperature and photoperiod do not interfere with the behavior of mussels. The mussel monitor is easier to handle as the replacement of the organisms takes less time, no individual control recordings are needed and feeding does not interrupt the measurements. Used in natural waters the mussels are self-maintaining. Hence, the mussel system is more feasible for wide-spread industrial applications that the fish respiration as it is more reliable and can be installed and operated at about 20% lower costs. (Baker-IVI)
W84-01423

USE OF FLUORESCENCE SPECTROSCOPY FOR MONITORING PETROLEUM HYDROCARBON CONTAMINATION IN ESTUARINE AND OCEAN WATERS,

Adelaide Univ. (Australia). Dept. of Physical and Inorganic Chemistry.
W. A. Maher.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 1, p 413-419, April, 1983. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Monitoring, *Industrial wastes, *Fluorescence, Oil industry, Hydrocarbons, Organic compounds, Estuarine environment, Pollutant identification, Naphthalene.

Aromatic hydrocarbons were extracted from water samples after adjustment of pH to 4.0-5.0. The aromatic hydrocarbon content of the extracts was estimated by fluorescence emission spectroscopy. Solutions were excited at 300 nm, the emission scanned from 310-500 nm and the fluorescence emission intensity of the main peaks measured and reported as equivalents of m-terphenyl and chrysene. One liter samples of seawater were spiked with 1 microgram of either Tapis Bulai crude, Barrow Island crude or lubricating oil and analyzed by extraction and spectrofluorimetry. Recoveries of all oils were greater than 95%. Water samples were also collected from locations near potential sources of petroleum hydrocarbon inputs. The fluorescence emission intensity of extracts of 330 nm and 380 nm varied depending on the source of petroleum hydrocarbons. Measurement at 330 nm gave a better indication of petroleum discharges near the boat marine and sewerage inlet. Measurement at 330 nm and 380 was more suitable for monitoring potential inputs from oil refineries and storm water drains. The study showed that if fluorescence spectroscopy is to be used to monitor petroleum contamination of estuarine and sea waters, the fluorescence emission of extracts should be measured at least at two wavelengths to allow the detection of fuel oil, lubricating oil and crude oil inputs. Thus the measurement of the fluorescence emission of water extracts provides a rapid means of monitoring petroleum hydrocarbon contamination. (Baker-IVI)
W84-01425

X-RAY MICROANALYSIS OF PLANKTIC DIATOMS IN IN SITU STUDIES OF METAL POLLUTION,
Uppsala Univ. (Sweden). Inst. of Ecological Botany.
G. Lindahl, K. Wallstrom, G. M. Roomans, and M. Pedersen.
Botanica Marina, Vol. 26, No. 8, p 367-373, August, 1983. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Metals, *Diatoms, *X-ray spectroscopy, Microscopic anaylsis, Plankton, Heavy metals, Water pollution effects, Seasonal variation, Sweden.

X-ray microanalysis was applied to in situ studies of metal accumulation in plankton organisms, especially diatoms, in Skellefte Bay, a heavily polluted coastal area in northern Sweden. The metal load of the area is in the approximate order Fe>As>Mn>Zn>Cu>Pb>Cd. The metal accumulation in the plankton organisms was not proportional to the relative metal content in the water. Fe and Cu, which were most frequently accumulated, were found in connection to the silica frustules of the diatoms, probably as a result of ion exchange between the metals and the algae. Seasonal differences in the frequency of metal accumulation are most probably an effect of changes in the environmental conditions mainly due to variations in fresh water influence. Some unusual contaminants were found (such as Zr) which would probably have been missed by more conventional methods of analysis. The large variations within a single sample make the analysis of many cells necessary before representative values for the overall composition of the sample are obtained. Macroscopic comparisons between plankton samples are probably still best carried out by more conventional methods of analysis. X-ray microanalysis is, however, clearly a valuable tool in the interpretation of such comparisons. (Moore-IVI)
W84-01476

QUALITY CONTROL IN WATER ANALYSES,
Weston (Roy F.), Inc., West Chester, PA
C. J. Kirchmer
Environmental Science and Technology, Vol. 17, No. 4, p 174-186, April, 1983. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Water analysis, *Standards, Quality control, Testing procedures, Laboratories.

Although quality control has become an accepted and even required practice in water analysis labs, the definitions and principles underlying the practice of quality control still need to be critically evaluated. A distinction must be made between the errors of the analytical method and the errors of results. Great emphasis must be placed on specifying methods accurately and completely. There are six possible sources of bias or systematic error in water analyses: unrepresentative sampling, instability of samples between sampling and analysis, interference effects, biased calibration, a biased blank correction, and the inability to determine all forms of the determinand. A survey of standard methods and government approved methods of water analysis in the US indicates that the possibility of biased calibration curves or biased calibration factors resulting from the use of different analytical procedures for standards and samples is not widely recognized. Accurate analyses depend primarily on the implementation of a well conceived within the laboratory quality control program involving two stages: preliminary error estimation and routine quality control from the use of appropriate control charts. Between lab tests should involve two stages also: comparison of standard solutions used by each lab with a standard distributed by coordinating lab and the collaborative analysis of samples distributed to all labs by a coordinating lab. (Baker-IVI)
W84-01494

APPLICATION OF CONTINUOUS-FLOW ULTRAFILTRATION AND COMPETING LIGAND/DIFFERENTIAL SPECTROPHOTOMETRY FOR MEASUREMENT OF HEAVY METALS COMPLEXATION BY DISSOLVED ORGANIC MATTER,
Illinois State Water Survey Div., Champaign.
J. R. Tuschall, Jr., and P. L. Brezonik.
Analytica Chimica Acta, Vol. 149, p 47-58, May, 1983. 3 Fig, 2 Tab, 29 Ref. PFR-78-19199, EPA-R-806286020.

Descriptors: *Organic matter, *Heavy metals, *Metal complexes, Ultrafiltration, Spectrophotometry, Polyaspartic acid, Swamps, Copper, Metal binding.

Continuous ultrafiltration and competing ligand/differential spectrophotometric methods were developed to quantify metal complexation by naturally occurring aquatic organic matter. Results for copper(II) ion complexation by organic matter in two swamp waters and by a model compound (polyaspartic acid) were compared to values obtained by the established ion-selective electrode method. Copper(II) solution was added, and the parameters used to quantify complexation were the metal-binding capacity of the organic matter and conditional stability constant (beta') of the metal-organic complexes. Copper complexed strongly with the organic material at pH 6.25; beta' values ranged from 10(5.3) to 10(8.5). Values obtained with the three procedures compared well. (Author's abstract)
W84-01557

INTERFERENCES OF MAJOR ELEMENTS IN THE DETERMINATION OF LEAD, COPPER, CADMIUM, CHROMIUM AND NICKEL IN RIVER SEDIMENTS AND SEWAGE SLUDGES BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY (INTERFERENCES DES ELEMENTS MAJEURS SUR LA DETERMINATION DE PB, CU, CD, CR ET NI DANS LES SEDIMENTS DE COURS D'EAU ET LES BOUES DE STATIONS D'EPURATION PAR SPECTROMETRIE D'ABSORPTION ATOMIQUE SANS FLAMME),
Laboratoire Central des Ponts et Chaussees, Paris (France).
M. Legret, D. Demare, P. Marchandise, and D. Robbe.
Analytica Chimica Acta, Vol. 149, p 107-114, May, 1983. 1 Fig, 6 Tab, 10 Ref. English summary.

Descriptors: *Sediments, *Spectrometry, *Sludge, *Heavy metals, Interference, Metals, Lead, Copper, Cadmium, Chromium, Nickel.

The interferences of major elements of river sediments and sewage sludges (Fe, Al, Mg, Ca, Na, Ti and P) in the determination of Pb, Cu, Cd and Ni by electrothermal atomic absorption spectrometry are studied and the concentration ra found in these environments are specified. L cadmium and chromium were subject to the r interferences. (Author's abstract)
W84-01558

ZONE TRAPPING IN FLOW INJECTI ANALYSIS; SPECTROPHOTOMETRIC TERMINATION OF LOW LEVELS OF AMM NIUM ION IN NATURAL WATERS,
Centro de Energia Nuclear na Agricultura, Pir caba (Brazil)
F. J. Krug, B. F. Reis, M. F. Gine, E. A. G. Zagatto, and J. R. Ferreira.
Analytica Chimica Acta, Vol. 151, p 39-48, 198 Fig, 1 Tab, 17 Ref.

Descriptors: *Ammonium, *Flow injection ana sis, *Spectrophotometry, Water analysis, Z trapping, Metals, Interference.

In flow injection analysis, selected portion o processed sample zone can be removed and, aft predetermined period of time reintroduced into same carrier stream. This zone-trapped technic easily applied, is suitable for methods based relatively slow chemical reactions in which se tivity or sampling rate is critical. It has so advantages over the stopped-flow and intermitte flow approached. The technique was studied fo model system without chemical reaction, and v then applied in a sensitive spectrophotomet method for the determination of ammonium ion natural waters, based on a modified Berthelot re tion. In zone trapping, the main portion of reacting sample zone is retained in a 38 C wa bath so that about 80% complete reaction achieved without limiting the sampling rate. T proposed method is suitable for 90-100 me urements per hour with a relative standard de ation of 0.5% for a typical sample (0.15 mg ammonium). Beer's law is followed up to 1 mg and the detection limit is 5 micro g/l. Interferenc of metals are overcome with EDTA. The resu for waters agree well with those obtained by standard manual procedure. (Author's abstract)
W84-01559

AN ELECTROMIGRATION METHOD FO STUDYING TECHNETIUM IN GROUN WATER UNDER OXIC AND ANOXIC COND TIONS,
Commission of the European Communities, Isp (Italy). Joint Research Centre.
A. Chatt, G. Bidoglio, and A. DePlano.
Analytica Chimica Acta, Vol. 151, p 203-210, 198 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Technetium, *Electromigratio Groundwater, Water analysis, Anoxic condition Diffusion coefficient.

A free-liquid electromigration method is describ for studying the occurrence of technetium ground water. Cells made of pyrex glass, tefl and plexiglass were examined for adsorption, diffu sion, and electro-osmotic effects. Of the three ce designed, the pyrex glass cell is not recommende for use. The teflon cell can be particularly useful situations where adsorption of reduced species the cell is suspected. The plexiglass cell can re ably employed to determine mobility values und both oxic and anoxic conditions. Average mob ities of 0.000538 in oxic conditions and 0.000515 cm/s/V in anoxic conditions were obtained for th pertechnetate ion in ground water (ionic streng 0.003 M) at 24 C. The effective diffusion coef cient of this ion was calculated as 0.0000137 cm/s for oxic conditions. (Moore-IVI)
W84-01560

THE RAPID DETERMINATION OF ALGA CHLOROPHYLL AND CAROTENOID PIG MENTS AND THEIR BREAKDOWN PROD UCTS IN NATURAL WATERS BY REVERSE

E HIGH-PERFORMANCE LIQUID
)MATOGRAPHY,
te for Marine Environmental Research,
uth (England).
C. Mantoura, and C. A. Llewellyn.
ica Chimica Acta, Vol. 151, No. 2, p 297-
ugust, 1983. 8 Fig, 3 Tab, 35 Ref.

ptors: *Chromatography, *Chlorophyll,
enoids, Algae, Pigments, Chlorophyllides,
horbides, High-performance liquid chroma-
ny.

rse-phase high-performance liquid chroma-
ic (h.p.l.c.) system is developed for a rapid
20 min) separation and quantification of
n chlorophylls and their breakdown prod-
d seventeen carotenoids from acetone ex-
f algal cultures and natural waters. An ion-
reagent is included to achieve good resolu-
th the acidic chloropigments (chlorophyll-
id phaeophorbides). Fluorescence and ab-
e detectors are used to quantify chloropig-
nd carotenoids respectively, with detection
f 0.01-0.2 ng for these pigments and 200-600
arotenoids. Chlorophyll a at concentrations
g/l may be detected in sea water. Methanol
n to be unsuitable for extracting pigments
it causes allomerization and transesterifica-
chlorophyll pigments in samples containing
wn products grossly overestimates the
concentration of these pigments, as deter-
y h.p.l.c. (Author's abstract)
561

OPMENT OF A NOVEL METHOD FOR
TORING OILS IN WATER,
mental Monitoring and Support Lab.-Cin-
OH.
awahara, R. A. Fiutem, H. S. Silvus, F. M.
n, and J. H. Frazar.
a Chimica Acta, Vol. 151, p 315-327, 1983.
Tab, 10 Ref. R 805817-01.

ors: *Hydrocarbons, *Monitoring, Oil pol-
Lasers, Optical fibers, Aromatic com-
Organophilic compounds.

or for hydrocarbons in water is described.
ad optical fiber, inserted through a stain-
capillary, is coated with an organophilic
id such as octadecyltrichlorosilane. The
diation is at 632.8 nm from a low-power
ne normal total internal reflection is de-
by adsorption of hydrocarbons in the or-
ic coating, because of the change in re-
index at the surface of the optical fiber,
variation in output signal can be related to
centration of hydrocarbon in the water
through the capillary. Aromatics, crude
oil products dispersed in water can be
d directly, without solvent extraction. In
nt form, the monitor can detect diesel oil
at 17 mg/l and crude oil at 3 mg/l.
er, a relationship appears to exist between
bility of a hydrocarbon and the detection
d of the monitoring system. With the
rganophilic coating, the use of an optical
h a suitable detector will be promising for
and measurement of such contaminants
ibly, for specific types. (Author's abstract)
62

SEPARATION BY FLOTATION OF
DED SOLIDS IN FRESH WATERS
E DETERMINATION OF ADSORBED
METALS,
Univ. (Japan). Faculty of Engineering.
de, J. Mizutani, and A. Mizuike.
a Chimica Acta, Vol. 151, p 329-337, 1983.
Tab, 10 Ref.

ors: *Heavy metals, *Suspended solids,
n, Adsorption, Ultrasound, Atomic ab-
spectrometry, Wastewater analysis, Water

m or nanogram quantities of heavy metals
on suspended solids are selectively float-
e solution surface by bubbling for 15 s.
he flotation, negatively charged suspend-
ed solids are rendered hydrophobic and coagulated by stirring with a cationic surfactant and sodium chloride. Metal ions, humic acid complexes and colloidal hydrated metal oxides are not floated at all. After the separation of the suspended solids, the trace heavy metals are desorbed by ultrasound in 4 M nitric acid and determined by electrothermal atomic absorption spectrometry. This rapid and convenient flotation technique is successfully applied to the analysis of river, pond and waste waters. (Author's abstract)
W84-01563

IDENTIFICATION OF A MEMBRANE FOULANT IN THE ELECTRODIALYTIC RECOVERY OF NICKEL,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
For primary bibliographic entry see Field 5B.
W84-01577

DETERMINATION OF PHOSPHORUS IN NATURAL WATERS BY LONG-CAPILLARY-CELL ABSORPTION SPECTROMETRY,
Tokyo Univ. (Japan). Dept. of Chemistry.
W. Lei, K. Fujiwara, and K. Fuwa.
Analytical Chemistry, Vol. 55, No. 6, p 951-955, May, 1983. 4 Fig, 6 Tab, 13 Ref.

Descriptors: *Colorimetry, *Phosphorus, Water analysis, Sea water, Natural waters, Lake Katsumigaura, Japan.

Use of a long capillary cell (LCC) effectively enhances the detection power of ordinary colorimetry. The minimum necessary volume of sample is about 1-3 mL. By application of this method to molybdenum-blue colorimetry, 5 pg/mL of phosphorus is detectable. Phosphorus concentrations less than 1 ng/mL in seawater and lake water are successfully determined by using LCC. LCC produced good coincidence with values obtained for ordinary colorimetry in studies on phosphorus concentrations in Lake Kasumigaura (Japan). The advantages of LCC are low cost of construction, simple manipulation, and high stability of obtained signal. Although the use of the present system is limited to the visible region due to poor internal reflection of LCC at shorter wavelengths, the method is extensively applicable in colorimetry. (Moore-IVI)
W84-01578

DETERMINATION OF TRIALKYLLEAD COMPOUNDS IN WATER BY EXTRACTION AND GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
W. R. A. De Jonghe, W. E. Van Mol, and F. C. Adams.
Analytical Chemistry, Vol. 55, No. 7, p 1050-1054, June, 1983. 5 Fig, 6 Tab, 34 Ref.

Descriptors: *Trialkyllead compounds, *Atomic absorption spectrometry, Lead compounds, Water pollution, Light, Extraction.

A simple extraction procedure is described for the sensitive determination of traces of trialkyllead compounds in water. After enrichment of the sample by a fast vacuum distillation technique and saturation of the residual volume with sodium chloride, the analytes are extracted in chloroform. By incorporation of specific purification steps, interference from other forms of organic and inorganic lead is completely eliminated. The final chloroform extract is treated with a sulfuric acid solution in order to transfer the trialkyllead compounds present back into an aqueous solution. The analysis is completed by graphite furnace atomic absorption spectrometry. Under normal laboratory conditions, a detection limit of 0.02 micro g can be achieved with 1-L samples. The method was developed to investigate the occurrence of trialkyllead compounds in environmental water samples. Experiments with spiked lake water have established that there is a considerable loss of initially added triethyllead chloride upon exposure to sunlight, while trimethyllead remains fairly stable. (Author's abstract)
W84-01579

DETERMINATION OF ARSENIC AND PHOSPHORUS COMPOUNDS IN GROUNDWATER WITH REDUCED MOLYBDENUM BLUE,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Analytical Chemistry, Vol. 55, No. 8, p 1205-1210, July, 1983. 2 Fig, 4 Tab, 30 Ref. R805281010.

Descriptors: *Arsenic, *Phosphorus, *Colorimetry, Molybdenum blue, Groundwater, Water analysis, Arsenic compounds, Phosphorus compounds, Silica, Interference, Fluoride.

Chemical studies were made to optimize reduced molybdenum blue for arsenic and phosphorus determinations in chemically diverse groundwaters. Phosphate strongly catalyzes the development of the arsenic(V) molybdate complex; Increasing H(+) or H(+):Mo retards complexation, but the effect is greater for the potentially interfering silicomolybdate complex. The oxidation of As(III) to As(V) by iodate partially inhibits the subsequent color development of silica. Iodide has no effect. Fluoride ion partially suppresses silica color development, probably because of competetive Si-F complexing at low pH. The molybdate responses of As(V), P, and SiO2 mixtures are not color additive. Optimum reaction conditions are H(+) = 0.30 N; H(+):Mo = 88 for arsenic and phosphorus determinations in the presence of silica. Silica is an important analytical interference for the lower H(+) and H(+):Mo conditions recommended by several popular procedures. (Author's abstract)
W84-01580

CATION-EXCHANGE CONCENTRATION OF BASIC ORGANIC COMPOUNDS FROM AQUEOUS SOLUTION,
Ames Lab., IA.
J. R. Kaczvinsky, Jr., K. Saltoh, and J. S. Fritz.
Analytical Chemistry, Vol. 55, No. 8, p 1210-1215, July, 1983. 2 Fig, 3 Tab, 33 Ref. CHE-7906108.

Descriptors: *Cation-exchange resin, *Organic compounds, Water analysis, Wastewater analysis, Gas chromatography.

A macroreticular poly(styrene-divinylbenzene) cation-exchange resin is prepared. An aqueous sample is passed through a column of this resin in the H(+) form and organic bases are taken up as cations. Washings with methanol and ethyl ether remove sorbed neutral and acidic compounds. Ammonia gas is introduced into the column prior to elution of the basic organics with either methanol or ethyl ether containing ammonia. The eluate is concentrated by evaporation, and the concentrated sample is analyzed by gas chromatography. Over 50 organic bases are recovered from water at the 1 ppm and 50 ppb levels. Recoveries of over 85% are achieved for most of the compounds studied with at least one of the eluents. The resin procedure shows improved recoveries and reproducibility over a simple ether extraction procedure. Real samples of river water, shale process water, and supernatant from an agricultural chemical disposal pit are analyzed for basic organic material by using the resin procedure. (Author's abstract)
W84-01581

PRECONCENTRATION OF TRACE ELEMENTS IN NATURAL WATER WITH CELLULOSE PIPERAZINEDITHIOCARBOXYLATE AND DETERMINATION BY NEUTRON ACTIVATION ANALYSIS,
Public Health Research Inst. of Kobe City (Japan).
S. Imai, M. Murol, and A. Hamaguchi.
Analytical Chemistry, Vol. 55, No. 8, p 1215-1219, July, 1983. 4 Tab, 4 Ref.

Descriptors: *Trace elements, *Neutron activation analysis, *Water analysis, Natural waters, Preconcentration.

To prepare cellulose piperazinedithiocarboxylate (PID), tosylcellulose was reacted with piperazine to give the aminocellulose which was then reacted with carbon disulfide. The preconcentration of the trace elements was accomplished by the PID column operations. Ten liters of river water or spring water sample was passed through the column at a given pH. The packings were taken out of the column, dried at 110 degrees C, and then burned to ashes in a low-temperature plasma asher. The ashes were encapsulated in polyethylene 'rabbits' of the pneumatic tube system and subjected to neutron irradiation in a reactor. Gamma-ray spectrometry was then performed on the irradiated sample and the concentration of 18 elements in natural water samples was determined. This method may be applied to atomic absorbtion spectrophotometry and emission spectrophotometry since PID can be readily decomposed by low-temperature plasma ashing. This method may be recommended as a simple and rapid simultaneous determination method for trace elements in natural water samples. (Moore-IVI)
W84-01582

PRECISION AND ACCURACY IN THE DETERMINATION OF ORGANICS IN WATER BY FUSED SILICA CAPILLARY COLUMN GAS CHROMATOGRAPHY/MASS SPECTROMETRY AND PACKED COLUMN GAS CHROMATOGRAPHY/MASS SPECTROMETRY,
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
J. W. Eichelberger, E. H. Kerns, P. Olynyk, and W. L. Budde.
Analytical Chemistry, Vol. 55, No. 9, p 1471-1479, August, 1983. 5 Fig, 7 Tab, 16 Ref.

Descriptors: *Gas chromatography, *Mass spectrometry, *Organic compounds, Water analysis.

Two general methods for the identification and measurement of organic compounds in water are compared. One method employs packed column chromatography and the other fused silica capillary column chromatography. The two gas chromatography/mass spectrometry (GC/MS) methods use different pH conditions for the liquid-liquid extractions with methylene chloride. Single laboratory total method accuracy and precision data are presented for over 80 analytes in water at the low parts per billion level. With the packed column method, 54% of the analytes have a mean recovery of 70% or more. With the capillary column method, 74% of the analytes have a mean recovery of 70% or greater. Both methods give mean relative standard deviations for concentration measurements of about 20%. (Author's abstract)
W84-01583

DETERMINATION OF HALOGENATED ORGANIC COMPOUNDS IN WATER BY GAS CHROMATOGRAPHY/ATMOSPHERIC PRESSURE HELIUM MICROWAVE-INDUCED PLASMA EMISSION SPECTROMETRY WITH A HEATED DISCHARGE TUBE FOR PYROLYSIS,
Tokyo Univ. (Japan). Dept. of Chemistry.
K. Chiba, and H. Haraguchi.
Analytical Chemistry, Vol. 55, No. 9, p 1504-1508, August, 1983. 5 Fig, 5 Tab, 16 Ref.

Descriptors: *Halogenated hydrocarbons, *Water analysis, *Gas chromatography, Plasma emission spectroscopy, Trihalomethanes, Seawater, Monochlorobenzene, Drinking water, Water pollution.

Gas chromatography/atmospheric pressure helium microwave-induced plasma emission spectrometry has been applied to the determination of halogenated, organic compounds in tap, pond, and river waters and seawater, as well as deionized and distilled waters. A quartz plasma discharge tube of 200 mm length was heated to 900 C for pyrolysis, since a 100 mm long conventional discharge tube without heating showed nonuniform relative responses due to incomplete decomposition of some compounds when it was used to transfer the column effluent to the microwave-induced helium plasma (MIP). Halogenated organic compounds in aqueous samples were collected on an Tenax GC column by a gas purge-and-trap method. Trihalomethane compounds including monochlorobenzene were found at the microgram per liter levels in tap and river waters, while their levels were much lower in pond water and seawater. Deionized and distilled waters also contained halogenated compounds at approximately the same levels as tap water. These results indicate that deionization and distillation processes do not exclude organohalide compounds in tap water. There was no evidence for organoiodine compounds in water (Moore-IVI)
W84-01584

SCALE MORPHOLOGIC RESPONSE TO AROMATIC HYDROCARBONS,
Grambling State Univ., LA. Dept. of Biology
V. Henderson.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 3, p 315-321, September, 1983. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Fish, *Toxicity, *Hydrocarbons, Fish scales, Fuel, Water pollution effects, Melanophores.

A simple and inexpensive procedure was developed to assess the toxic effects of aromatic hydrocarbons utilizing scales, without sacrificing the fish. Mosquito fish (Gambusia affinis) were exposed to 3.45 mg/l hydrocarbons from the water-soluble fraction of shale-derived JP-4 fuel for 48 hr. Scales from the exposed and unexposed fish were examined by light microscopy and scanning electron microscopy (SEM). The changes observed with the electron microscope manifested themselves in an arborization and an increase in total number of melanophores leading to preponderance of stellate-reticulate melanophores. An increase in pigment was a function of the type and number of melanophores present. Surface cell morphology with SEM provides another parameter for assessing damage to cells. This method can drastically reduce the evaluation time required to assess pollutants. (Moore-IVI)
W84-01587

QUALITATIVE AND QUANTITATIVE DETERMINATION OF DISSOLVED HYDROCARBONS IN WATER AND SEDIMENTS (ANALYSE QUALITATIVE ET QUANTITATIVE DE TRACES D'HYDROCARBURES DISSOUS DANS L'EAU ET IMPREGNANT DES SEDIMENTS),
Strasbourg-1 Univ. (France). Lab. de Physicochimie des Hydrocarbures.
P. Rimmelin, P. Muller, M. Sagar, J. Kontaratos, and J. Sommer.
Analusis, Vol. 11, No. 7, p 345-349, August-September, 1983. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Hydrocarbons, *Water analysis, *Sediment analysis, *Extraction, Gas chromatography, Solvents, Sodium chloride, Methanol.

An inert gas stripping method for the extraction of trace amounts of hydrocarbons from water for gas chromatography is improved by the addition of sodium chloride and methanol. The method can also be applied to contaminated sediments analysis. The method was applied to a mixture of 10 hydrocarbons at 20 C with an output of gas of 120 ml/min under the following conditions; (A) without additive, 60 min analysis time; (B) with 10 g/l NaCl, 30 min; with 2 ml/l methanol, 30 min. The analysis time was cut in half with the additives, and the quantities of extracted hydrocarbons are equal or greater than those extracted in condition A. (Moore-IVI)
W84-01612

CHARACTERISTICS OF ESCHERICHIA COLI GROWN IN BAY WATER AS COMPARED WITH RICH MEDIUM,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 2L.
W84-01649

REDUCTIVE DEHALOGENATIONS OF LOBENZOATES BY ANAEROBIC LAKE MENT MICROORGANISMS,
Michigan State Univ., East Lansing. Dept. of and Soil Sciences.
A. Horowitz, J. M. Suflita, and J. M. Tiedje.
Applied and Environmental Microbiology, 45, No. 5, p 1459-1465, May, 1983. 6 Fig, 1 Ta Ref.

Descriptors: *Microorganisms, *Dehalogen *Halobenzoates, Lake sediments, Halogens, mation, Metabolism, Methane, Chlorobenz Bromobenzoates, Idobenzoates, Anaerobic tions.

Methane-producing freshwater lake sediment found to dehalogenate chloro-, bromo-, and benzoates by a reductive reaction in which halogen was replaced by a hydrogen atom. identity of the dehalogenated products was firmed by mass spectrometry, nuclear mag resonance, or cochromatography. Removal o halogens to produce benzoate was nece before mineralization to CH4 + CO2 could o The dehalogenation occurred after a lag p which lasted from 1 week to more than 6 mo depending on the chemical. Dehalogenation not observed in the absence of CH4 produc and it was inhibited by the addition of 20% Once sediment was acclimated to haloben dehalogenation, new additions of the haloben were degraded without lag. Acclimation wa served regardless of whether the parent subst were eventually mineralized to CH4 + CO2. ment acclimated to bromo- and chloroben degradation generally metabolized bromo- chlorobenzoates, but sediment acclimated to benzoate degradation only metabolized iodo zoate. Prior acclimation of sediment to ben decomposition did not alter the pattern of de genation, and sediment acclimated to dehalog tion was not concurrently acclimated to ben degradation. The presence of this apparent s ficity, the lag period, and subsequent acclima together with our findings of the absence of d logenation in sterile sediments and by sedim previously incubated at greater than or equal degrees C, suggests that this reaction was bio cally catalyzed. Apparently, a pathway for reductive dehalogenation of aryl halides is pr in anaerobic microorganisms of this methanog sediment. (Author's abstract)
W84-01650

THE INTERPRETATION OF COMP CHROMATOGRAMS BY COMPUTER ANA SIS,
Anglian Water Authority, Huntingdon (Engla
C. R. Hayes, and N. P. Weatherill.
Water Resources, Vol. 17, No. 5, p 539-548, M 1983. 7 Fig, 1 Tab, 2 Ref.

Descriptors: *Gas chromatography, *Mass s trometry, *Computers, Pollutant identifica Water analysis, Water quality.

A computer system was developed to hand large volume of data derived from gas chrom graphic (GC) and mass spectrometric (MS) an sis of environmental water samples. The sys was developed using GC and GC-MS data duced in the analysis of dichloromethane extr of water samples from five river catchments three treatment works. GC profiles were quanti to provide a concise presentation of data and results, from a limited number of samples, w used to ascribe probable identification to the c ponents of GC profiles for which no MS anal was performed. The statistical analysis of an ical performance characteristics provided the b for the method adopted for cross referencing and GC data. A method for ranking compo identifications ascribed to GC profile compon is based on whether the compound had been pr ously been identified at the same site and frequency of occurrence, and whether the c pound had previously been identified at the s treatment works or catchment and the freque of occurrence. (Moore-IVI)
W84-01673

CULATE FORMS OF RADIUM AND M IN URANIUM MINE WASTE S AND RECEIVING RIVER WATERS,
ysoke Uceni Technicke v Praze. Dept. of Chemistry.
, F. Sebesta, J. Sedlacek, M. Obdrzalek, andrik.
esources, Vol. 17, No. 6, p 619-624, June, Fig, 6 Tab, 9 Ref. IAEA contract 1729/

ors: *Radium, *Barium, *Mine drainage, lates, Uranium mines, Selective dissolu- precipitation, Effluents, Wastewater treat- ttom sediments, Suspended solids.

od of selective dissolution was used for of particulate forms of radium and barium tem consisting of uranium mine waste urified by coprecipitation with barium sul- of adjacent river waters. Four particulate both the elements were distinguished: ound, acid soluble, Ba(Ra)SO4 and in e detritus. It was found that the distribu- adium and barium between dissolved and e forms in waste waters depended on the rval elapsing between the sampling and e filtration of the waters. No such de- occurred in river water. The main par- orm of radium and barium in the sysfem (Ra)SO4. River water upstream of the er discharge contained radium mainly in ble form or in crystalline detritus and BaSO4 or crystalline detritus. In unpuri- effluents, a large part of radium and as present as crystalline detritus. Abun- the loosely bound form was very low in mples analyzed. The bond of radium in ediments was approximately the same as e solids suspended in waste waters. Suit- d accuracy of the selective dissolution or analysis of surface and waste waters demonstrated by the analysis of the re- by radiotracer experiments. (Author's

7

MICAL FACTORS COMPLICATING E OF AUFWUCHS AS A BIOMONI- R LEAD LEVELS IN TWO NEW RESERVOIRS,
The State Univ., New Brunswick, NJ. Environmental Science.
vman, A. W. McIntosh, and V. A.

ources, Vol. 17, No. 6, p 625-630, June, ig, 1 Tab, 17 Ref. DE-AC09-76-SR00-

rs: *Lead, *Aufwuchs, *Algae, *Moni- eochemistry, Biomonitoring, Iron, Man- eavy metals, New Jersey.

ccumulating on glass slides was sampled om two reservoirs for 1 year. Monthly lead concentration in these samples lated with fluctuations in associated iron anese concentration. Correlation with algal cell density was also significant 0.05), yet not as important in the statisti- as iron plus manganese concentration. oscopic examination, it was evident that ty of the material removed from the a rust-colored matrix. X-ray analysis at the majority of the lead in the materi- from the slides was associated with this nanganese-rich matrix surrounding the not with the microflora itself. As a material scraped from the slides (often aufwuchs in biomonitoring efforts) e considered a valid biomonitor of lead ese reservoirs. The local geochemistry, a, was the dominant factor affecting the ntrations in the material accumulating ss slides. The findings of this study potential for misinterpretation of bio- efforts employing procedurally defined Author's abstract)

CATION OF ORGANIC COM- N LEACHATE FROM A WASTE TIP,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 5B.
W84-01682

FLOW ANALYSIS FOR THE DETERMINATION OF THE MAIN COMPONENTS OF WATERS, RAIN WATER AND DRINKING WATER (DURCHFLUBMETHODEN ZUR BESTIMMUNG VON HAUPTKOMPONENTEN IN GEWASSERN, REGENWASSER UND TRINKWASSER),
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
H. F. R. Reijnders, P. H. A. M. Melis, and B. Griepink.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 314, No. 1, p 627-633, April, 1983. 194 Ref.

Descriptors: *Water analysis, *Chemical analysis, Drinking water, Rain, Flow-through analysis, Alkalinity, Chloride, Nitrite, Nitrate, Phosphate, Sulfate, Ammonium, Potassium, Lithium, Sodium, Barium, Calcium, Magnesium, Strontium, Literature review.

A survey of the literature concerning flow-through determination of the main components in various types of water is given. These components are: alkalinity, chloride, nitrite, nitrate, phosphate, sulfate, ammonium, potassium, lithium, sodium, barium, calcium, magnesium and strontium. Details with regard to e.g. type of water, range of the method, interferences etc. are given in a separate compilation which is available from the editor upon request. (Author's abstract)
W84-01729

APPLICATION OF HIGH-SPEED LIQUID CHROMATOGRAPHY USING SOLVENT EXTRACTION OF THE MOLYBDOHETEROPOLY YELLOW TO THE DETERMINATION OF MICROAMOUNTS OF PHOSPHORUS IN WASTE WATERS,
Hamamatsu Univ. (Japan). School of Medicine.
N. Sakurai, K. Kadohata, and N. Ichinose.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 314, No. 1, p 634-637, April, 1983. 4 Fig, 5 Tab, 5 Ref.

Descriptors: *High-speed liquid chromatography, *Phosphorus, *Wastewater analysis, Interference, Silicon compounds, Molybdoheteropoly yellow, Solvent extraction.

In the determination of phosphorus in wastewaters, the usual method is the spectrophotometry of molybdoheteropoly blue, but this is complicated because the color of silico molybdoheteropoly blue, developed simultaneously, can interfere with the determination. A method for determining microamounts of phosphorus in wastewater by HPLC is based on the solvent extraction of molybdoheteropoly yellow with methyl propionate. The corresponding silicon compound is not extracted into this solvent. Thus, the interference by silicon is excluded. Microamounts of phosphorus can be determined not only in waste water but also in river water rapidly and exactly. The limit of detection is 0.5 ppm, and the coefficient of variation is 4.7%. (Moore-IVI)
W84-01730

DETERMINATION OF TRACES OF POLYOXYETHYLENE NON-IONIC SURFACTANTS IN WATER BY SOLVENT EXTRACTION-SPECTROPHOTOMETRY,
Government Industrial Research Inst., Osaka (Japan).
T. Saito, and K. Hagiwara.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 315, No. 1, p 201-214, June, 1983. 2 Fig, 5 Tab, 9 Ref.

Descriptors: *Nonionic surfactants, *Spectrophotometry, Solvent extraction, Sodium picrate, Surfactants, Water analysis, Interference.

The determination of traces of polyoxyethylene non-ionic surfactants (APE) in water is based on the formation of a complex between APE and sodium picrate. The complex is extracted into 1,2-dichloroethane and the absorbance of the solvent phase is measured at 378 nm. Quarternary ammonium surfactants and iron(III) caused positive errors, but the interference due to iron(III) was effectively masked with CyDTA. Humic acids, anionic surfactants, common cations and anions did not interfere. For general type APE (n = 8 - 13) the apparent molar absorptivities of the picrate complexes were 5 - 7 times larger than those of cobalt thiocyanate complexes. Various polyethoxylated compounds in the range of n from 9 to 85 in the same quantity were almost the same in absorbance; recoveries of APE were about 93 - 107%. Therefore this method is quite usable. As little as 0.04 ppm can be determined. In a river water sample 0.04-0.05 ppm and in another case 0.34 ppm of APE were found. (Author's abstract)
W84-01731

DETERMINATION OF PHENOL IN INDUSTRIAL WASTE WATER BY ISOTACHOPHORESIS,
Innsbruck Univ. (Austria). Inst. fuer Radiochemie und Angewandte Physikalische Chemie.
P. A. Pfeifer, G. K. Bonn, and O. Bobleter.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 315, No. 1, p 205-207, June, 1983. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Phenol, *Isotachophoresis, Industrial wastewater, Wastewater analysis, Electrochemical separation, P-cresol, Vanillin, Interference.

Isotachophoresis constitutes a method of electrochemical separation and identification of ionic substances. By variation of pH, temperature, leading and terminating electrolytes an optimal system for the determination of phenol in waste water was found. All samples were examined without preliminary chemical or physical treatment and therefore a direct analysis of waste water containing phenol is possible. The limit of the sensitivity for phenol is 0.1 ppm. Compounds such as p-cresol and vanillin do not interfere with the phenol determination. (Moore-IVI)
W84-01732

A NEW CALIBRATION METHOD FOR THE NITRATE TRACE DETERMINATION IN WATER SAMPLES (EIN NEUES EICHVERFAHREN ZUR NITRAT-SPURENBESTIMMUNG IN WASSERPROBEN),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
K. G. Heumann, and M. Unger.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 315, No. 5, p 454-458, July, 1983. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Nitrates, *Mass spectrometry, Isotope dilution analysis, Water analysis, Ionization, Drinking water.

The development of a new method for the mass spectrometric isotope dilution analysis of nitrate traces is described. The formation of negative NO2(-) thermal ions at a hot metal surface is used for the mass spectrometric detection. The optimum conditions for the ionization process depending on the filament material, the filament temperature and the sample compound are discussed. Enriched N15 labeled NO3(-) is used as a spike solution. By this method the nitrate traces could be analyzed down to the ng/g-level. In the concentration range 10-30 micro g/g which is especially important for drinking water, the relative external standard deviation of the analyses is 0.1%. As the described isotope dilution technique is a definitive method without any external standardization it is especially suitable as a calibration method. (Author's abstract)
W84-01733

DETERMINATION OF HEAVY METALS IN SEDIMENTS BY X-RAY FLUORESCENCE IN SEM (QUALITATIVE AND QUANTITATIVE EVALUATION): PART I:TECHNIQUE (QUALITATIVE UND QUANTITATIVE RONTGENAN-

Group 5A—Identification Of Pollutants

ALYSE VON SCHWERMETALLEN IN SEDIMENTEN IM REM DURCH RONTGEN-FLUORESCENZ-ANREGUNG TEIL 1: METHODIK),
Bonn Univ. (Germany, F.R.). Hygiene Inst.
J. U. Hahn, and H. F. Scholer.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 315, No. 8, p 679-682, August, 1983. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Heavy metals, *X-ray fluorescence, *Sediment analysis, Scanning electron microscopy, Computers.

A procedure for qualitative and quantitative analysis of sediments is described. The sample preparation and evaluation of the measurement results are suitable for routine analysis. The heavy metals were determined by energy dispersive X-ray fluorescence analysis in SEM (scanning electron microscopy) and the quantitative analysis was carried out by micro-computer. The limits of detection are below 100 ppm. The confidence interval is 99.7%. (Author's abstract)
W84-01735

DETERMINATION OF HEAVY METALS IN SEDIMENTS BY X-RAY FLUORESCENCE IN SEM (QUALITATIVE AND QUANTITATIVE EVALUATION); PART 2: APPLICATION (QUALITATIVE UND QUANTITATIVE RONTGENANALYSE VON SCHWERMETALLEN IN SEDIMENTEN IM REM DURCH RONTGEN-FLUORESCENZ-ANREGUNG; TEIL 2: ANWENDUNG),
Bonn Univ. (Germany, F.R.). Hygiene Inst.
J. U. Hahn, and H. F. Scholer.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 315, No. 8, p 683-686, August, 1983. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Sediment analysis, *Metals, *X-ray fluorescence, Heavy metals, Cadmium, Chromium, Manganese, Iron, Nickel, Copper, Zinc, Thallium, Arsenic, Lead, Multivariate analysis.

Sediments from a small river (Lauterbach) were examined for the metals and metalloids Cd, Cr, Mn, Fe, Ni, Cu, Zn, Tl, As, Pb. Nineteen samples were taken at regular intervals. The trace metals were determined by means of X-ray fluorescence in scanning electron microscopy. Intercorrelations between various metals were evaluated by multivariate statistical methods. (Author's abstract)
W84-01736

5B. Sources Of Pollution

METHANOGENESIS OF PHENOLIC COMPOUNDS BY A BACTERIAL CONSORTIUM FROM A CONTAMINATED AQUIFER IN ST. LOUIS PARK, MINNESOTA,
Geological Survey, Menlo Park, CA.
E. M. Godsy, D. F. Goerlitz, and G. G. Ehrlich.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 3, p 261-268, March, 1983. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Groundwater contamination, *Fate of pollutants, Methanogenesis, Phenols, Methane, Coal tar, Industrial wastes.

Groundwater in St. Louis Park, Minnesota has been contaminated by the operation of a coal tar distillation and wood treatment facility. Water samples were collected at three wells from the near-surface groundwater in the contaminated area. Well W13 is located near the centroid of the contaminated zone directly under the area where the plant process liquids penetrated the subsurface. Water from Well P14, located 143 m down gradient in the direction of groundwater flow from Well W13, does not have a hydrocarbon phase but does have a distinct creosote odor. This well penetrates the area of active microbiological activity. Water from Well P119, located 430 m down gradient from Well W13, does not have a distinct creosote odor and is beyond the area of active microbiological activity. The chromatograms of the phenols from samples from Well W13 and those from two laboratory digestors are nearly comparable. The peak heights of the chromatogram of Well P14 are attenuated relative to W13 owing to biodegradation and hydrodynamic dispersion in the groundwater. Phenol, 2-methylphenol, and 3-methylphenol apparently degraded during transport over the 143 m distance from Well W13 to Well P14. This study demonstrated that phenols, a major fraction of coal tar, were degraded in both groundwater and in laboratory digestors with a concomitant production of methane. (Baker-IVI)
W84-01419

CADMIUM UPTAKE AND INDUCTION OF CADMIUM-BINDING PROTEIN IN THE WATERFLEA (MOINA MACROCOPA),
National Inst. for Environmental Studies, Tsukuba (Japan).
M. Yamamura, S. Hatakeyama, and K. T. Suzuki.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 3, p 298-302, March, 1983. 3 Fig, 8 Ref.

Descriptors: *Zooplankton, *Biological magnification, *Cadmium, Moina, Protein, Metallothioneins, Waterflea, Adsorption, Accumulation, Fate of pollutants.

The accumulation and chemical forms of cadmium in the zooplankton, Moina macrocopa, were investigated in order to more fully understand the accumulation of cadmium in various steps through the food chain. M. macrocopa were collected and kept in aerated water tanks at 23 C. Cadmium was added to underground water in the tanks at a concentration of 20 micrograms Cd/liter. The animals exposed to cadmium were collected after 0, 24, 48, and 72 hr. Concentrations of cadmium, zinc, and copper were determined. The concentration of cadmium attained a maximum level after 72 hr. At this time the concentrations of zinc and copper were not affected, remaining at control levels. Approximately 60% of the cadmium in the homogenates was extracted into the supernatant fraction and the metal concentration in the supernatants increased with accumulation of the metal in the animals. The cadmium accumulated in M. macrocopa was mainly bound to the low molecular weight cadmium-binding protein whose molecular weight is smaller than that of mammalian metallothioneins. The protein is a mixture of two isoproteins as in the case of malacostracan metallothioneins. (Baker-IVI)
W84-01421

ACCUMULATION OF SEVEN METALS BY CRASSOSTREA GIGAS, CRASSOSTREA MARGARITACEA, PERNA PERNA, AND CHOROMYTILUS MERIDIONALIS,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
H. R. Watling.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 3, p 317-322, March, 1983. 3 Tab, 18 Ref.

Descriptors: *Mollusks, *Fate of pollutants, *Accumulation, Chromium, Copper, Zinc, Lead, Cadmium, Nickel, Cobalt, Metals.

The accumulation of seven elements by Crassostrea margaritacea, Perna perna and Choromytilus meridionalis was investigated. The rates of accumulation were compared with those achieved by Crassostrea gigas under the same controlled conditions. Experimental solutions containing 100 micrograms/liter of one of the elements were used. The study showed that all seven elements were accumulated to a greater or lesser extent by each of the four species. Exposures lasted 3 weeks. During this period the oysters accumulated zinc and copper at the fastest rates, lead and cadmium at intermediate rates and the remaining elements were accumulated more slowly. Lead is accumulated at the fastest rate by the mussels. Zinc and cadmium in both mussels and copper in P. perna were accumulated at intermediate rates and, as found in the oyster, nickel, cobalt, and chromium were accumulated very slowly. The zinc levels tested were significantly below those already found in many so-called polluted areas. The toxic effect of copper in possibly causing a low mulation rate cannot be discounted. F point of view of indicating metal pollutio marine environment, the tissue-metal conc which is determined for individuals from ed environment must be significantly gre those determined for individuals from an ed area. On the basis of the accumulation f appeared that zinc has not been accumulat these experimental conditions by either o mussels. Moderate accumulation factors h determined for cadmium, copper, nickel, a mium and the very high accumulation fac mated for lead and cobalt suggest that t ments are accumulated very rapidly. It is s that all three species could be used to ind presence of each of these elements in the environment, with the exception of zinc. IVI)
W84-01422

AN ALGAL ASSAY METHOD FOR DE NATION OF COPPER COMPLEXATI PACITIES OF NATURAL WATERS,
Illinois Inst. of Tech., Chicago. Pritzker Environmental Engineering.
H. E. Allen, C. Blatchley, and T. D. Brisbi
Bulletin of Environmental Contaminat Toxicology, Vol. 30, No. 1, p 448-455, Ap 3 Fig, 2 Tab, 21 Ref. 31-109-38-3660, 022044030.

*Bioassay, *Algae, Assay, Copper, Comp Natural waters, Metal complexes, Toxicity

For a series of natural waters a compari made of the copper complexation capacit termined by the Davey method using algae, Selanastrum capricornutum, to tha mined by plotting the free copper ion co tion versus the growth rate. The eight water samples included Lake Michigan fr cago's 31st street pier in September 197 bodies of water in Forest Preserve i County, IL in August 1978 and one more ber 1978; and Par and Beaver Ponds an Three Runs River, located in Georgia in 1979. The natural water samples were enriched by the addition of phosphate an at levels equivalent to those in AAT med Algal Assay Procedure Bottle Test). The c ation capacities determined for natural w the Davey and the biological titration were statistically the same. However, th methods differ in an important way. For method only those data in the vicinity equivalence point are used. For the biologi tion all data can be used if the complex is For weaker complexes, the data for tot concentration similar to that of the comp capacity will deviate from linear behavior. cases the data which deviate can be disre The biological titration method is easier because it does not require that a sig number of samples have metal concentratio lar to the value of the complexation c (Baker-IVI)
W84-01427

ORGANOCHLORINE RESIDUES IN NISMS OF TWO DIFFERENT LAGOO NORTHWEST MEXICO,
Universidad Nacional Autonoma de Mexico City. Centro de Ciencias del Mar y logia.
M. T. L. Rosales, and R. L. Escalona.
Bulletin of Environmental Contaminati Toxicology, Vol. 30, No. 1, p 456-463, Apr 2 Fig, 3 Tab, 7 Ref.

*Pesticides, *Aquatic life, *Lagoons, Mexic Mollusks, DDT, Heptachlor epoxide, Endrin, Dieldrin, Chlorinated hydroc Tropical regions, Semiarid lands, Mexico.

The concentration of organochlorine com was determined in two lagoon systems with ent backgrounds: the Yavaros lagoon sy Sonora and the Huizache-Caimanero lagoo plex in Sinaloa Mexico. The Yavaros c

of the Yavaros, Moroncarit, and Etchor-
oons, each of which receives drainage
om an extensive agricultural hinterland.
uizache-Caimanero systems consist of a
wo-basined lagoon lying between and
ccess to the rivers Presidio and Baluarte.
varos area is semi-arid with low summer
The Huizache-Caimanero is a tropical
d has a much higher summer rainfall.
f organochlorine pesticides (total HCH,
DT, heptachlor epoxide, aldrin, endrin and
were measured in several organisms
ne year period, including striped mullet,
ullet, mackerel, flounder, Centropomus
s, C. robalito, shrimp, crab and clams.
varos lagoon has a uniform salinity of ap-
ely 37 0/00 which reflects the high marine
. In the Moroncarit area the influence of
re predominates over the marine effects.
nity distribution over a year in the Hui-
imanero lagoon shows that there is a high
ion in the area from March to June and an
drying of the lagoons which increases
In general, the levels of DDT and dieldrin
in organisms of the two areas studied are
an the range of values reported in the
. The concentration of organochlorine
ds found below the widely accepted
s that represent hazard to human health
g wet weight for DDT and 100 ng/g wet
r dieldrin). (Baker-IVI)
28

**S OF GRAYS HARBOR ESTUARY
NT ON THE OSMOREGULATORY
Y OF COHO SMOLTS (ONCORHYN-
ISUTCH),**
Engineers, Seattle, WA. Seattle District.
hoe.
of Environmental Contamination and
gy, Vol. 30, No. 5, p 522-529, May, 1983.
Ref.

sediments, *Dredging, *Salmon, *Heavy
Estuaries, Grays Harbor, Washington,
Toxicity, Sodium, Turbidity, Harbors.

es which have experienced large amounts
metal pollution the bottom sediments
bind the heavy metals from the water
nd act as a sink for storage of the con-
. The effect of sediments from Grays
Washington, on the hypo-osmoregulatory
smolting coho salmon was investigated
he measurement of blood sodium levels
seawater challenge. Experiments were
to simulate, as closely as possible, the
migrating juvenile coho salmon of the
igh suspended sediment levels created by
redges while dredging in the inner harbor.
erimental groups were established, each
of three replicate tanks containing 20
nk. The control group was held in non-
ated freshwater for 9 days, then immedi-
ected to a 24 hr seawater challenge test.
recovery group was exposed to sediment
, then immediately subjected to the 24 hr
challenge test. The 5-day recovery group
d in freshwater contaminated with sedi-
9 days, and were then placed into clean
r for a 5 day recovery period. They were
cted to the 24 hr seawater challenge test.
ay recovery group was placed in fresh-
taminated with sediment for 9 days and
ed into clear freshwater for a 10-day
period. After this they were subjected to
seawater challenge. A great deal of vari-
rbidity levels occurred in the experimen-
throughout the contaminant exposure
ith levels of about 200 NTU's being
ccasionally. The mean turbidity level in
control tanks was 0.89 NTU. Chemical
f the elutriate from the Grays Harbor
owed the presence of a variety of heavy
ood sodium levels of groups in the three
nks had a mean reading of 157 meg/liter;
ee zero-hour recovery tanks a mean of
iter; in the three 5-day recovery tanks a
68 meg/liter; and in the 10-day recovery
ean of 181 meg/liter. Dissolved oxygen
re not below 7.0 milligrams per liter in
easured in the study. (Baker-IVI)
2

DISTRIBUTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE SURFICIAL SEDIMENTS OF CASCO BAY, MAINE,
Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
P. F. Larsen, D. F. Gadbois, A. C. Johnson, and L. F. Doggett.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 5, p 530-535, May, 1983. 1 Fig, 1 Tab, 10 Ref. NA-80-FA-C-0008.

*Hydrocarbons, *Sediments, *Pollutant identification, Fate of pollutants, Casco Bay, Maine, Carcinogens, Polycyclic aromatic hydrocarbons.

Thirty stations were sampled in Casco Bay in April of 1980 to determine the presence of hydrocarbons in the sediments. Each of the 16 PAH's tested was detected at between 1 and 30 of the test sites. Eight compounds: pyrene, benzo-a-anthracene, chrysene, benzo-b-fluoranthrene, benzo-a-pyrene, dibenzo-a,h-anthracene, benzo-g,h,i-perylene and indeno-1,2,3-c,d-pyrene occurred at over 73% of the stations. All 16 individual PAH's exhibited concentrations in the hundred ppb range at specific points and eight exceeded 1,000 ppb wet weight at least at one station. The highest individual concentration was that of benzo-b-fluoranthene at station 37 which measured 4,500 ppb. Individual stations manifested between 3 and 13 PAH compounds with a mean of 8.57. Total concentrations of PAH at the 30 stations ranged between 215 and 14.425 ppb with a mean of 2.164 ppb. With only one exception stations in the upper and mid sections of the Bay were characterized by values of 900 ppb and below. Concentrations above 2,000 ppb were limited to stations in the vicinity of Portland, including the principal shipping channel into Casco Bay and the mouth of the Presumpscot River. It would seem that a definite possibility exists for the contamination of the living marine resources of this commercially important area. (Baker-IVI)
W84-01433

MERCURY DISTRIBUTION IN AN ECOSYSTEM OF THE 'PARQUE NACIONAL DE DONANA,' SPAIN,
Consejo Superior de Investigaciones Cientificas, Madrid (Spain). Inst. de Quimica Organica General.
G. Baluja, L. M. Hernandez, J. Gonzalez, and R. Clavero.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 5, p 544-551, May, 1983. 2 Tab, 12 Ref.

*Mercury, *Birds, *Fish, *Soil, Spain, Fate of pollutants, Ecosystems, Soil contamination, Heavy metals.

The Parque Nacional de Donana in Spain serves as a winter habitat for migratory birds which breed in Northern Europe. Various levels of mercury were found in the soils of the shore around both the Lucio de Mary Lopez and Lucio del Cangrego Grande lagoons located within the ecosystem. The soil around the Mary Lopez lagoon had a mercury load 2.4 times that at the Cangrego Lagoon. The mean level of mercury in the soil of Mary Lopez lagoon amounts to 0.234 ppm and that at the Cangrego amounts to 0.098 ppm. The average mercury content of the crust of the earth has been calculated at about 0.5 ppm. The rushes growing on the shore of the Mary Lopez lagoon contain 0.41 ppm mercury as opposed to 0.17 ppm in rushes growing on the Cangrego shore. Fish sampled in the Cangrego and Mary Lopez lagoons showed various levels of mercury that appear to increase according to feeding habits. A widespread distribution of mercury was noted from data recorded on birds. Birds of exclusively vegetal feeding showed smaller levels of contamination than those with omnivorous food habits. Only the spoon bill, mostly carnivorous, sampled in the Mary Lopez area showed a 0.87 ppm of total mercury, the highest level found. Eggs showed two different mercury levels according to the food habits of the parents. Duck eggs contained a mean level of 0.07 ppm while those from a more carnivorous bird showed a mean of 0.21 ppm, three times higher. Thus it is evident that mercury occurs in this area of the reserve, but it seems that most of this mercury has a natural origin. (Baker-IVI)
W84-01435

ADSORPTION OF FENITROTHION AND 3-METHYL-4-NITROPHENOL ON SOILS AND SEDIMENT,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Chemistry.
W. H. Baarschers, J. Elvish, and S. P. Ryan.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 5, p 621-627, May, 1983. 4 Tab, 16 Ref.

*Fenitrothion, *Absorption, *Soil properties, Phenols, Sediments, 3-Methyl-4-Nitrophenol, Fate of pollutants, Forests, Microbial degradation.

The absorption characteristics of fenitrothion and 3-methyl-4-nitrophenol, its hydrolysis product, on several soils were studied. Four soils and a Lake Superior sediment were used. Both chemicals were adsorbed on sediment and soils in amounts that increased with increasing organic matter content of the adsorbate. Whereas the use of K-values derived from the Freundlich equation has limitations, the use of a modified Freundlich equation presents problems when the slope of the isotherm is appreciably larger than unity. Both compounds can be adsorbed on soils so as to reach concentrations that are fungi-toxic on agar plates. Since compounds adsorbed on soil (and on the organic litter of the forest floor) would not be readily subject to photodegradation, the results of this study indicate that it is necessary to give attention to further studies on the microbial degradation of these compounds. (Baker-IVI)
W84-01439

FRACTIONATION OF PHOSPHORUS AND RELEASABLE FRACTION IN SEDIMENT MUD OF OSAKA BAY,
Osaka Prefecture Fisheries Experimental Station (Japan).
H. Joh.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 49, No. 3, p 447-454, March, 1983. 7 Fig, 11 Ref.

Descriptors: *Phosphates, *Sediments, Bays, Seawater, Path of pollutants, Anaerobic conditions, Osaka Bay, Japan.

This report discusses fractionation of phosphorus in sediment cores of Osaka Bay and the releasable fraction from sediment to sea water in anaerobic condition. Inorganic phosphate in sediment mud was fractionated into four types: soluble-P, Al-P, Fe-P, and Ca-P by the method of Chang et al. Concentrations of Al-P and Fe-P indicate the highest value in 0-5 cm layer except for Al-P in Stn. 4 which is located at the most inner part of the bay. Ca-P contents show relatively high value for each sediment core, ranging from 110 to 190 micro g per g dry mud, but area and vertical variances were not so clear. As Al-P plus Fe-P contents in the sediment increase exponentially with ignition loss; most phosphates which are associated with pollutant substances in the sediment mud are in these two fractions. Three fractions of phosphate: soluble, aluminum and iron phosphate may be released from the sediment in anaerobic condition. It was proved that contents of phosphate released into sea water increased proportionally to those three fraction contents in sediment mud. (Author's abstract)
W84-01454

WETFALL CHEMISTRY STUDIES AROUND A LARGE COAL-FIRED POWER PLANT IN THE SOUTHEASTERN UNITED STATES,
Brookhaven National Lab., Upton, NY. Atmospheric Sciences Div.
A. A. N. Patrinos, M. T. Dana, and R. E. Saylor.
Journal of Geophysical Research, Vol. 88, No. C13, p 8585-8612, October 20, 1983. 22 Fig, 19 Tab, 57 Ref.

Descriptors: *Acid rain, *Air pollution, *Powerplants, Plume washout, Sulfur, Hydrogen ions, Chloride, Sulfur dioxide, Simulation, Chemistry of precipitation, Gas scavenging.

A wetfall chemistry study was conducted within a 15-km radius of a large coal-fired power plant in the southeastern United States. The study was conducted during the winter of 1981 and included event precipitation sampling on a dense network of 31 stations, selected air chemistry monitoring at two sites, and extensive meteorological measurements. The precipitation samples were analyzed for all major inorganic ionic species, including dissolved sulfur dioxide. The meteorological network included a preexisting network of 49 recording rain gages and four surface windsets, the power plant's fully equipped meteorological station, and a bistatic acoustic sounder. This paper presents the results from five of the sampled storms. Plume washout is evident in most target area samples, and sulfur, hydrogen ion, and chloride ion were found to be the predominant plume-related species. Concentrations in the affected regions exceeded the background levels by up to 100% in the case of sulfur and of hydrogen ion, and by up to 145% in the case of chloride ion. Two of the storms were characterized by excess dissolved SO2 amounts in the target samples; for these storms, scavenging model simulations of dissolved SO2 concentrations indicated that deposition of sulfur by SO2 scavenging within 12 km was probably less than 2% of the total emitted. Based on the measured Cl(-) in rainwater, an estimate of the source strength (coal Cl content) using conventional gas scavenging theory appears reasonable. (Author's abstract)
W84-01492

CHARACTERIZATION OF NONVOLATILE AQUEOUS CHLORINATION PRODUCTS OF HUMIC SUBSTANCES,
Massachusetts Univ., Amherst. Dept. of Chemistry.
J. W. Miller, and P. C. Uden.
Environmental Science Technology, Vol. 17, No. 3, p 150-157, March, 1983. 13 Fig, 1 Tab, 28 Ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Humic acids, Hydrogen ion concentration, Fulvic acid, Chloroform, Dichloroacetic acid, Trichloroacetic acid, Chloral hydrate.

The formation of nonvolatile chloroorganics produced during the aqueous chlorination of humic substances was followed qualitatively and quantitatively. The effects of reaction time, NaOCl to C ratio, pH, and source of humic material were studied with respect to the quantitative formation of chloroform, dichloroacetic acid, trichloroacetic acid, and chloral hydrate. Other gas-chromatographable chloroorganics formed from the chlorination of fulvic acid were produced at levels below these four compounds. Chlorine-selective fingerprint studies were also undertaken to follow the formation of 17 major chlorinated products. (Author's abstract)
W84-01493

MOBILITY IN SOIL AND PLANT AVAILABILITY OF METALS DERIVED FROM INCINERATED MUNICIPAL REFUSE,
Tennessee Valley Authority, Muscle Shoals, AL. Div. of Agricultural Development.
P. M. Giordano, A. D. Behel, Jr., J. E. Lawrence, Jr., J. M. Solleau, and B. N. Bradford.
Environmental Science Technology, Vol. 17, No. 4, p 193-198, April, 1983. 9 Tab, 16 Ref.

Descriptors: *Fly ash, *Leaching, *Heavy metals, Incineration, Municipal wastes, Cadmium, Lead, Chloride, Soil contamination, Waste disposal.

Fly ash residues from several sites in which solid municipal refuse is being incinerated for energy production were found to contain excessive amounts of cadmium and/or lead according to an empirical extraction test (0.5 N acetic acid) developed by the Environmental Protection Agency. Samples of associated bottom ashes contained acceptable levels of Cd and Pb, but several were marginal with respect to Pb content. Leaching tests clearly demonstrated that Cd and, to a lesser extent, Pb were mobile in soil when applied in a fly ash matrix. The high chloride content (10-12%), which is characteristic of these ashes, resulted in metal complexation and enhanced Cd and Pb mobility in soil. Normally these elements are relatively immobile in soils when applied as inorganic salts or contained in municipal sewage sludge. Plant uptake of Cd and Pb in a greenhouse test was marked when fly or finely ground bottom ashes were solid applied. Phytotoxicity of fly ash appeared to be associated with the high salt content rather than with a specific metal. (Author's abstract)
W84-01495

PARTITION EQUILIBRIA OF NONIONIC ORGANIC COMPOUNDS BETWEEN SOIL ORGANIC MATTER AND WATER,
Oregon State Univ., Corvallis. Environmental Health Sciences Center.
C. T. Chiou, P. E. Porter, and D. W. Schmedding.
Environmental Science and Technology, Vol. 17, No. 4, p 227-231, April, 1983. 2 Fig, 1 Tab, 34 Ref. ES-02400, ES-00210, CR-808046.

Descriptors: *Isotherms, *Soil organic matter, *Partition, Organic compounds, Solutes, Sorption, Aromatic compounds, Polymeric humic substances.

Equilibrium isotherms for the simultaneous uptake of binary nonionic organic compounds from water on soil indicated no competitive effect between the two solutes. This observation supports the hypothesis that partition to the soil organic phase is the primary process for sorption of nonionic organic compounds from water on soil. The partition process between soil organic matter and water was analyzed by using the conventional solution concept for solutes in water and the Flory-Huggins treatment for solutes in the polymeric humic phase. Sorption determined for 12 aromatic compounds on a Woodburn soil shows that the extent of solute insolubility in water (S) is the primary factor affecting the soil organic matter-water partition coefficient (Kom) and that the effect of solute incompatibility with soil organic matter is significant but secondary. This explains the commonly observed correlations of log Kom vs. log S and log Kom vs. log Kow (octanol-water). (Author's abstract)
W84-01497

PARTITIONING OF STRONTIUM-90 AMONG AQUEOUS AND MINERAL SPECIES IN A CONTAMINATED AQUIFER,
National Hydrology Research Inst., Ottawa (Ontario).
R. E. Jackson, and K. J. Inch.
Environmental Science Technology, Vol. 17, No. 4, p 231-237, April, 1983. 6 Fig, 3 Tab, 42 Ref.

Descriptors: *Partition, *Strontium radioisotopes, *Groundwater pollution, Groundwater movement, Adsorption, Sand aquifers, Path of pollutants, Vermiculite, Feldspar.

The geochemical partitioning of a toxic metal contaminant, Sr90, during its migration through a shallow sand aquifer is discussed. Adsorption of Sr90 from the contaminated groundwaters (pH about 6, I about 0.001) causes it to have a migration velocity of only 3% of that of transporting groundwater. Five microscopically identified adsorbents were isolated in the aquifer sediments and showed the following affinity sequence for Sr90: vermiculite > feldspar > biotite > muscovite > quartz. While about 80% of the adsorbed Sr90 is exchangeable with 0.1 M SrCl2, the residual adsorbed Sr90 is strongly correlated with extractable Fe, Al, and Mn, suggesting specific adsorption by these metal oxides. An equilibrium adsorption model was used to determine the partitioning of Sr90 between adsorbents and between solid and solution phases. Over 90% of all Sr90 in the aquifer is adsorbed. Approximately 90% of all adsorbed Sr90 is equally divided between vermiculite and feldspar minerals. (Author's abstract)
W84-01498

STRUCTURE ELUCIDATION OF 3-(2-C OETHOXY)1,2-DICHLOROPROPENE, PROMUTAGEN FROM AN OLD DRI WATER RESIDUE,
Cincinnati Univ., OH. Dept. of Enviro Health.
M. W. Tabor.
Environmental Science Technology, Vol. 6, p 324-329, June, 1983. 1 Fig, 3 Tab, CR806872, CR808603.

Descriptors: *Mutagens, *Chlorinated h bons, Drinking water, Water pollution, identification, Chloroallyl ethers, Promuta

A Salmonella TA100 microsomal-depende gen previously isolated from residue orga pared from drinking water in the 1960s carbon-chloroform megasampler proced now been tentatively identified as a new lyl ether. On the basis of Fourier trans frared and nuclear magnetic resonance spe pies in conjunction with high-resolution m troscopy, a confident structual assignment promutagen was elucidated to be 3-(2-ch oxy)-1,2-dichloropropene. The compound been noted in studies of current drinkin residue organics and the mutagenicity o drinking water samples typically does no such microsomal activation. (Moore-IVI)
W84-01502

APPLICATION OF VAN KREV GRAPHICAL-STATISTICAL METHO THE STUDY OF AQUATIC HUMIC M AL,
Laval Univ., Quebec. Dept. of Soil Sicence
S. A. Visser.
Environmental Science and Technology, No. 7, p 412-417, July, 1983. 5 Fig, 5 Tab,

Descriptors: *Humic acids, *Fulvic acids, ing organic matter, Ultraviolet irradiation, mycetes, Soil organic matter, Aquatic ment.

By means of H:C and O:C atomic ratios tion was obtained on the basic structure, structural changes with varying molecula and origin, of fulvic and humic acids sa various locations of a watershed within t entide provincial park, Quebec. In order t gate also the effect of humification, humi produced by a streptomycete and sampled lar intervals during a 6-month incubatio was included in the investigation. Also stu the effect of ultraviolet irradiation on the of either recently formed or more humifie substances. It was shown that fulvic an acids are more alike in aquatic than in t environments. They are also less aromatic ral waters than in soils and, at least in the fulvic acids, are richer in oxygen. Con what is normally observed for humus from environments, it would appear that for types of humus such as fulvic acids from bial culture, increases in molecular weight degree of humification would result in with a less aromatic character. Humus from natural waters was found to be in advanced state of humification at the summer than at the beginning. Recently fulvic acids appeared to be very sensitive violet irradiation. (Author's abstract)
W84-01508

FECAL COLIFORM LOADINGS FROM ON BRIDGES,
Gore and Storrie Ltd., Toronto (Ontario).
M. D. Palmer.
Canadian Journal of Civil Engineering, No. 2, p 241-247, June, 1983. 4 Fig, 5 Tab

Descriptors: *Water pollution sources, *C *Birds, *Bridges, Pollution load, Fecal c Feces, Pigeons, Rideau River.

The fecal coliform loadings to the Rideau from bird populations resident on bridg measured for dry weather, summer, lo

-17 cu m/s). The Rideau River has typi-
ties to 0.216 km/h. The loadings were
by an intensive river sampling program
eeks at river cross sections upstream and
m of a bridge with birds on the bridge
ut birds on the bridge. The birds were
y displaced from the bridge with bird
stical testing of the river cross section
means showed the birds to have a sig-
fect on river fecal coliform levels. From
s, river water sampling data, and river
a pigeon was estimated to generate on
e a daily loading of between 0.88 and 1.3
e 10th power fecal coliform organisms
ndard deviation of approximately 0.39 x
10th power. An independent check on
y of the estimated loadings from resident
ations at another bridge produced results
% of the measured values. (Author's ab-

FROM OILFIELD BRINE DISPOS-
S IN UTAH,
Univ. at Boulder. Dept. of Geological

r, and C. M. Brendecke.
ater, Vol. 21, No. 3, p 317-324, May-
4 Fig, 2 Tab, 6 Ref.

s: *Brine disposal, *Groundwater pollu-
e water, Seepage, Plumes, Water pollu-
es, Water pollution control, Economic
nitoring, Utah.

amounts of brine produced in conjunc-
il well operations in the Greater Alta-
ell field in Utah have been disposed of
impoundments. Mass balance calcula-
te that about 93% of this brine, a total
re-feet (5,450,000 cu m) over the ten-
l studied, is lost through seepage, intro-
otal salt load of 200 million pounds
kg) into the shallow aquifer system.
problems with groundwater supplies
observed to date, but estimates of salt-
e movement indicate that potential ad-
omic impacts on irrigators and other
in the Duchesne River Valley could
reds of thousands of dollars. Lining of
nds and increased use of injection wells
future contamination. A groundwater
water monitoring program should be
selected areas to determine the extent of
n, and to more accurately project the
amages caused by salt-water contamina-
ly, resistivity surveys could be made
observation wells be placed around
ee of the largest ponds, in order to
salt concentration in the groundwater
ermine the direction of plume move-
re-IVI)

ETHION IN CANALS DRAINING A
CITRUS GROVE,
of Tech., Melbourne. Dept. of Envi-
Sciences and Engineering.
erg, and R. J. Pfeuffer.
Agricultural and Food Chemistry, Vol.
704-709, July/August, 1983. 7 Fig, 1

*Ethion, *Pesticide residues, *Fate of
Organophosphorus pesticides, Hydroly-
n canals, Sediments, Adsorption, Hy-
concentration, Citrus fruits, Florida.

lation of ethion, O,O,O',O'-tetraethyl
ene bis (phosphorodithioate), in irriga-
waters draining a citrus grove in South
urs readily by hydrolysis with a half-
lays. The reaction is pH independent
to 7 with a pseudo-first-order rate
0.0048/day (half-life of 146 days).
7 the reaction is pH dependent with a
order rate constant increasing with
values, suggesting a base-catalyzed hyr-
second-order alkaline hydrolysis rate
.0064/M/day. Half-lives were 62 days
1 day at pH 10. Adsorption to canal sediments was negligible and desorption was rapid because of absence of significant amounts of organic matter. Calculations based upon solubility and vapor pressures of ethion indicate that the rate of evaporative loss is negligible. Ethion did not accumulate in the sediment and water samples from the irrigation canal following spraying, and levels never exceeded 0.017 mg/L in the water or 0.03 micro g/g (dry weight) in the sediments. This suggests that hydrolysis may be a significant mechanism in the loss of ethion from irrigation canal waters in South Florida.
W84-01556

OCCURRENCE OF BROMIDE IN SOURCE AND TREATED WATERS,
Imperial Coll. of Science and Technology, London (England).
T. V. Luong, C. J. Peters, and R. Perry.
Effluent and Water Treatment Journal, Vol. 23, No. 5, p 192-197, May, 1983. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Bromide, *Water pollution sources, Groundwater, Surface waters, Natural water, Trihalomethanes, Chlorination, Drinking water, Water treatment.

The method most widely adopted and recommended by the ASTM for determination of bromine is an UV spectrophotometric method based on bromide catalysis of iodine oxidation with a working range of 4-100 micrograms/l of bromide. A comparison is offered of this method against an instrumental neutron activation analysis. For unspiked samples the bromide levels obtained by ASTM were markedly lower than the INAA results. The reason for this divergence is that INAA measures total bromine including bromide, bromate and other forms of inorganic bromine as well as non volatile organic bromine, the ASTM method measures principally bromide and bromate. For tap water samples relatively high organic bromine levels are to be expected as significant amounts are produced during chlorination. Inorganic bromine occurs in natural waters principally as bromide although other forms such as bromate and possibly bromite may also be present. Neither the ASTM nor the INAA methods can distinguish between these species of inorganic bromine. An indirect measure of the organic bromine content can be obtained by the difference between INAA and ASTM determinations. For groundwaters bromide concentrations depend principally on the extent of salt water intrusion and the geochemical formation of the aquifer whereas for surface waters factors such as the extent of reuse, the type and quantity of industrial discharge and the potential of other sources of bromine such as road and agricultural runoff are important. (Baker-IVI)
W84-01569

IDENTIFICATION OF A MEMBRANE FOULANT IN THE ELECTRODIALYTIC RECOVERY OF NICKEL,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
H. C. Heller, and V. Markovac.
Analytical Chemistry, Vol. 55, No. 4, p 551A-557A, April, 1983. 5 Fig, 5 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, *Membrane processes, Water reuse, Nickel, Electroplating, Electrodialysis, Nickel, Membranes.

Some component present in a nickel plating additive formulation of a major supply company severly and rapidly fouled the membranes during an evaluation of the feasibility of nickel recovery by electrodialysis. Electrodialysis experiments were performed in an electrodialysis stackpack containing anion-selective membranes (103.QZL.219) and cation selective membranes (61.CZL.183). In a solution of identical nickel ion concentration obtained from post plating rinse and therefore containing the additive formulation, the voltage required to maintain 12.5 mA/sq cm in the electrodialysis process rose rapidly from 14 to 40 V in less than 60 min, indicating fouling of the electrodialysis membranes. Attempts to remove the fouling species included filtration through 0.25 micron Millipore filters, adsorption on activated carbon, diatomaceous earth, and polymeric adsorbants; and removal with ion-exchange columns. Ion-exchange columns saturated with foulant could be regenerated to 90% or better of their original capacity by treatment with hydrochloric acid or sodium chloride methanol-water solution. Polyallyl sulfonate was identified as a foulant of the membranes in the electrodialysis of the nickel plating solutions. A separate brightener formulation supplied by a different supplier and containing sodium allyl sulfonate exhibited no fouling. (Baker-IVI)
W84-01577

LAKE ST. CLAIR: SINCE THE MERCURY CRISIS,
Michigan Dept. of Natural Resources, Lansing.
J. H. Hartig.
Water Spectrum, Vol. 15, No. 1, p 19-25, Spring, 1983. 8 Fig.

Descriptors: *Fate of pollutants, *Mercury, *Lakes, *Fish, Lake St. Clair, Detroit River, Public Health, Lake Erie, Industrial wastes, Chemical industry, Regulations, Water pollution control.

In 1969 the mercury crisis in Lake St. Clair was clear. The contamination was arising from the Dow Chemical Chlor-Alkali Plant, in Sarnia, Ontario. Mercury had contaminated both the sediments and the fishery of the St. Clair River and lake, and the Detroit River. Today the monitoring programs have shown a significant decrease of mercury in all species of fish. In general, the concentration of mercury in fish from Lake St. Clair is less than one-third what it was in 1970. The decline of mercury in walleye is particularly significant as walleye are the most sought after sport fish in the lake. The Michigan Department of Public Health has dropped walleye, largemouth bass, smallmouth bass, sheepshead, and white bass from the Lake St. Clair's public health advisory. Only muskellunge are advised to be consumed no more than one meal per week because of elevated mercury levels. The decline has resulted mainly from the cessation of discharge of mercury on the St. Clair River and to the translocation of mercury-containing sediments from Lake St. Clair to Lake Erie. After May of 1970 mercury discharges to the St. Clair River were negligible. Resuspension and onward transportation of mercury containing sediments from Lake St. Clair to Lake Erie has resulted in a 64% decrease in sediment mercury in Lake St. Clair from 1970 to 1974. No major effects were noted in Lake Erie as a result of continued loading of mercury containing sediment from Lake St. Clair, via the Detroit River. The dilution factor in Lake Erie may have been adequate to prevent large-scale uptake of mercury by fishes, or mercury contaminated sediments are being bound and covered up by new sediments. (Baker-IVI)
W84-01640

MICROBIAL TRANSFORMATION OF NITROAROMATIC COMPOUNDS IN SEWAGE EFFLUENT,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
L. E. Hallas, and M. Alexander.
Applied and Environmental Microbiology, Vol. 45, No. 4, p 1234-1241, April, 1983. 7 Fig, 2 Tab, 26 Ref. PHS Training Grant ES-07052.

Descriptors: *Nitroaromatic compounds, *Wastewater, *Effluent, *Microbial degradation, Aromatic compounds, Aerobic conditions, Anaerobic conditions, Metabolism, Benzenes, Fate of pollutants.

The transformation of mono- and dinitroaromatic compounds was measured in sewage effluent maintained under aerobic or anaerobic conditions. Most of the nitrobenzene, 3- and 4-nitrobenzoic acids, and 3- and 4-nitrotoluenes and much of the 1,2- and 1,3-dinitrobenzenes disappeared both in the presence and absence of oxygen. Under anaerobiosis, 2,6-dinitrotoluene and 3,5-dinitrobenzoic acid disappeared slowly, but no loss was evident in 28 days in aerated sewage. Aromatic amines did not

accumulate during the aerobic decomposition of the mononitro compounds. They did appear in nonsterile, but not in sterile, sewage incubated aerobically with the dinitro compounds and anaerobically with all the chemicals. Analysis by gas chromatography and combined gas chromatography-mass spectrometry showed that aniline was formed from nitrobenzene, toluidine was formed from 3- and 4-nitrotoluenes, and aminobenzoic acid was formed from 3- and 4-nitrobenzoic acids under anaerobiosis, and that nitroaniline was formed from 1,2- and 1,3-dinitrobenzenes, aminonitrotoluene resulted from 2,6-dinitrotoluene, and aminonitrobenzoic acid was a product of 3,5-dinitrobenzoic acid under both conditions. The isomeric forms of the metabolites were not established. Aniline, 4-toluidine, and 4-aminobenzoic acid added to sewage disappeared from aerated nonsterile, but not from sterile, sewage or sewage in the absence of oxygen. 2-Nitroaniline, 2-amino-3-nitrotoluene, and 2-amino-5-nitrobenzoic acid added to sewage persisted for at least 60 days in aerobic or anaerobic conditions. Gas chromatographic and gas chromatographic-mass spectrometric analyses demonstrated that acetanilide and 2-methylquinoline were formed from aniline, 4-methylformanilide and 4-methylacetanilide were formed from 4-toluidine, 2-methylbenzimidazole was a product of 2-nitroaniline, and unidentified benzimidazoles were formed from 2-amino-3-nitrotoluene in the absence of oxygen, and that 2-nitroacetanilide and 2-methyl-6-nitroacetanilide were formed from 2-nitroaniline and 2-amino-3-nitrotoluene, respectively, in the presence or absence of oxygen. It is suggested that the transformations of widely used nitroaromatic compounds should be further studied because of the persistence and possible toxicity of products of their metabolism. (Author's abstract)
W84-01647

ENTRAINMENT OF VIRUSES FROM SEPTIC TANK LEACH FIELDS THROUGH A SHALLOW, SANDY SOIL AQUIFER,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
J. M. Vaughn, E. F. Landry, and M. Z. Thomas.
Applied and Environmental Microbiology, Vol. 45, No. 5, p 1474-1480, May, 1983. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Wastewater disposal, *Enteroviruses, *Entrainment, Viruses, Aquifers, Water pollution sources, Groundwater pollution, Water quality, Coliforms, Long Island, New York.

Movement of naturally occurring human enteroviruses from a subsurface wastewater disposal system through a shallow aquifer was studied on the south shore of eastern Long Island, New York. The potential for significant entrainment of virus particles was evidenced by their recovery at down-gradient distances of 67.05 m and from aquifer depths of 18 m. The specific limits of virus entrainment through the system could not be determined, as wells had not been installed beyond 67 m down-gradient of deeper than 18 m. A significant negative correlation was observed between virus occurrence and the distance from the 'septage' (leaching pool) source. Virus occurrence could not be statistically correlated with either total or fecal coliforms, indicating the limitations of current microbial water quality indicators for predicting virological quality of groundwater. (Moore-IVI)
W84-01651

LONGEVITY OF SALMONELLA TYPHIMURIUM IN TILAPIA AUREA AND WATER FROM POOLS FERTILIZED WITH SWINE WASTE,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
D. A. Baker, R. O. Smitherman, and T. A. McCaskey
Applied and Environmental Microbiology, Vol. 45, No. 5, p 1548-1554, May, 1983. 3 Fig, 3 Tab, 53 Ref

Descriptors: *Salmonella, *Wastewater aquaculture, *Aquaculture, *Tilapia, Public health, Wastewater disposal, Animal wastes, Bacteria.

Salmonella contamination is a potential public health concern in wastewater aquaculture, because humans and farm animals may shed salmonellae intermittently in their feces. Thus, fish being cultured in wastewater might come in contact with salmonellae. Field studies were conducted during the spring and summer of 1980 using 14 8,000 liter pools stocked with Tilapia aurea. Salmonella typhimurium declined rapidly when inoculated into T. aurea culture pools fertilized with fresh swine waste. Within the water column, a 95% decline of viable cells occurred during the first 6 h. Isolation of viable salmonellae was possible at 16 days post-inoculation, but not at 32 days. Similarly, salmonellae could be detected in the viscera and epithelium of T. aurea at 16 days, although not at 32 days. Salmonellae were not isolated from the fish flesh, nor was there evidence of septicemic infection. (Moore-IVI)
W84-01655

SEASONAL VARIATION IN SURVIVAL OF ESCHERICHIA COLI EXPOSED IN SITU IN MEMBRANE DIFFUSION CHAMBERS CONTAINING FILTERED AND NONFILTERED ESTUARINE WATER,
Virginia Inst. of Marine Science, Gloucester Point. Dept. of Estuarine and Coastal Ecology.
I. C. Anderson, M. W. Rhodes, and H. I. Kator.
Applied and Environmental Microbiology, Vol. 45, No. 6, p 1877-1883, June, 1983. 4 Fig, 43 Ref.

Descriptors: *Escherichia coli, *Estuarine environment, *Water temperature, Bacteria, Microorganisms, Public health, Water quality.

Human fecal Escherichia coli isolates were exposed over a seasonal cycle to estuarine water in diffusion chambers filled with double-filtered (0.45 and 0.2 micro m) and nonfiltered water. Laboratory manipulations of E. coli cultures before estuarine exposure were reduced to minimize sublethal stress, and nonselective or resuscitative enumeration techniques were employed to maximize recovery of stressed cells. E. coli was capable of extended survival during in situ exposure to estuarine water, provided eucaryotes were excluded from diffusion chambers. Survival was directly related to temperature in absence of the eucaryote component of the natural microbiota. Although it was not possible to prevent eventual bacterial contamination in double-filtered water, there was no direct evidence that such contamination affected E. coli survival. Conversely, E. coli disapparance was most pronounced at warmer temperatures in the presence of the natural microbiota, and decline coincided with increasing eucaryote densities. In contrast, the decline of E. coli during winter was similar in both filtered and nonfiltered seawater. (Author's abstract)
W84-01660

ENVIRONMENTAL EFFECTS OF IN SITU COAL GASIFICATION,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
M. J. Humenick, T. F. Edgar, and R. J. Charbeneau.
AICHE Symposium Series, Vol. 79, No. 226, p 139-153, 1983. 2 Fig, 6 Tab, 54 Ref.

Descriptors: *Coal gasification, *Water pollution sources, Organic compounds, Phenols, Gasification, Fate of pollutants, Surface waters, Groundwater pollution, Environmental effects.

This review evaluates the environmental impact of underground coal gasification. Documentation projects that pollutants are released to groundwaters when normal flow returns to a postgasification zone. During the gasification phase, the high temperature gases produced can migrate into surrounding strata, where cooling occurs with attendant condensation or deposition of various chemical compounds. The bulk of the condensed materials are organic compounds including light hydrocarbons, phenols, oils, and tars. After gasification is completed, an ash residue remains in the burn cavity which yields soluble inorganic compounds to reinvading groundwaters. Wastewaters generated above the ground arise principally from the gas cooling step, which causes condensation of oils, and tars from the gas generated in si condensate may contain three phases - wa and solids. The water phase can contain hi centrations of phenols and other organi pounds, ammonia, hydrogen sulfide, carbo ide and various inorganic compounds (Bak W84-01662

WATER QUALITY MONITORING AT HOE CREEK TEST SITE: REVIEW AND LIMINARY CONCLUSIONS,
Lawrence Livermore National Lab., CA.
F. T. Wang, S. W. Mead, and D. H. Stuerme
AICHE Symposium Series, Vol. 79, No. 154-173, 1983. 21 Fig, 7 Tab, 8 Ref. DOE C W-7405-Eng-48.

Descriptors: *Underground coal gasifi *Coal aquifers, *Water pollution sources, G water pollution, Sorption, Organic comp Sand aquifers, Water quality, Hoe Creek, ming.

Underground coal gasification (UCG) may duce a broad range of residual gasification ucts into the groundwater of a coal aquifer contaminants may be of environmental signi if they find their way, in sufficient concentr into surface waters or aquifers from which w extracted for drinking or agriculture. Sorp many contaminants by the coal itself is an tant factor in restricting the migration of contaminants in the groundwater. Field stu Hoe Creek in northeastern Wyoming have that sorption of organic compounds by coal as effective as expected, perhaps because th surface area is limited. Futhermore, if sever collapse has taken place during gasificatio coal aquifers located above the gasified coa may be interconnected with the coal aquifer taminants may enter these non-coal aquif which sorption is even less effective. Th Creek II and III experiments are a study th tamination of a sand aquifer located above fied coal seam in a hydrological recharge Preliminary results indicate that the water overlying sand aquifer is much less contam with organic compounds than that in the g coal aquifer. (Moore-IVI)
W84-01663

EUTROPHICATION PROBLEMS IN E ROMAGNA, ITALY,
Watson Hawksley, High Wycombe (England
M. V. Haddrill, R. Keffer, G. C. Olivetti, G. Polleri, and F. Giovanardi.
Water Resources, Vol. 17, No. 5, p 483-495 1983. 6 Fig, 8 Tab, 17 Ref.

Descriptors: *Nutrients, *Pollution load, phorus removal, *Nitrogen removal, *Eutro tion, Wastewater treatment, Detergents, A wastes, Land disposal, Sludge digestion, Emilia Romagna, River Savio, Adriatic Sea.

Between 1977 and 1979 a study identifie sources and forms of the nutrients phosphor nitrogen discharged from the basin of the Savio, in Emilia Romagna, Italy. Septic remove 30% of the phosphorus load from s in the study area, and there was a statis significant reduction in the load in the sewag result of the introduction of low phosphorus gents. The flow and nutrient loads carried river were monitored during dry and wet w to establish annual nutrient loads carried Adriatic Sea. While it was possible to reas balance the measured phosphorus loads wit mated loads, there was considerable disagre between the measured and estimated ni loads for the year July 1978 - June 1979, w estimated load much lower than the me load. An extensive sampling program was c out to quantify the principal sources of nutri which the most important were pig farming and chemical fertilizers. A significant reduct nutrient load could be achieved by treatm wastewaters from pig farming. Treatment include energy recovery by digestion of slud

l of wastewaters to land in a controlled
, thereby reducing considerably to load
g the sea. (Moore-IVI)
1670

CLE-SIZE DISTRIBUTION AND PHOS-
US LEVELS IN SOIL, SEDIMENT, AND
N DUST AND DIRT SAMPLES FROM
MENOMONEE RIVER WATERSHED,
ONSIN, U.S.A.,
sin Univ.-Madison. Dept. of Soil Science.
g, G. V. Simsiman, and G. Chesters.
Resources, Vol. 17, No. 5, p 569-577, May,
Fig, 3 Tab, 11 Ref. EPA grant R005142.

ptors: *Phosphorus, *Particle size, *Water
n sources, Sediments, Soil type, Urban
Suspended sediments, Roads, Nonpoint pol-
sources, Wastewater treatment plant, Wis-
Menomonee River Watershed.

ottom sediment, suspended sediment, and
treet dust and dirt samples from the Meno-
River Watershed, Wisconsin, were dis-
by ultrasound, fractionated and analyzed
P content of each of three particle-size
s. The major soil types in the watershed
sed as a reference for comparing particle-
tribution and P content in urban street dust
t, and in sediments. Phosphorus level was
o be greater in the clay-sized particles than
sand- or silt-sized particles of urban street
d dirt samples, but 48% of the P was in the
ed fraction because of the predominance of
ed particles in these samples. The highest P
the clay-sized fraction of the bottom sedi-
ccurred at the site below a sanitary treat-
ant (STP) outfall with secondary treatment
ty. The P level found below a tertiary STP
was equal to the level found in agricultural
When using P level in sediment for locating
possible P input to the river, the clay-sized
of bottom sediments was more precise
levels in unfractionated samples. (Author's
)
674

ATION (INCLUDING ADSORBED SPE-
OF COPPER, LEAD, NICKEL AND ZINC
E MEUSE RIVER; OBSERVED RESULTS
ARED TO VALUES CALCULATED
A CHEMICAL EQUILIBRIUM COM-
PROGRAM,
Univ. (Belgium). Dept. of Botany.
vet, and A. C. M. Bourg.
Resources, Vol. 17, No. 6, p 641-649, June,
Fig, 3 Tab, 34 Ref.

tors: *Bottom sediments, *Heavy metals,
tion, *Adsorption, Copper, Lead, Nickel,
Chemical equilibrium, Trace metals, Com-
Organic matter, Suspended sediments,
River, Eysden, Netherlands.

sediment samples (13) were collected from
site on the Meuse River at Eysden, Neth-
during 1978 and 1979. The adsorption of
etals on sediments was interpreted in terms
petition between metals and protons for
sites. Surface constants were determined
Zn and Cd (10 to the -1.8, 10 to the -3.6
to the -3.7). The constants for Pb, Ni, Ca
(10 to the -1.7, 10 to the -3.8, 10 to the -6.5
to the -5.2) were estimated using a correla-
tween hydrolysis and surface constants. A
al equilibrium computer program in which
sites (for adsorption reactions) are treated
entional ligands was used to calculate the
on of Cu, Pb, Ni and Zn in the Meuse
When the sample contents of humic acids
n and the suspended matter concentration is
e calculated percentages of metal adsorbed
restimated. A slight change in the assumed
ion capacity of those suspended particles
xcellent results. Dissolved trace metal con-
ons in the Meuse River are controlled by
ion and not by precipitation mechanisms.
ationship between organic matter and sus-
matter greatly influences the adsorption of
ike Cu and Pb. (Moore-IVI)
680

IDENTIFICATION OF ORGANIC COMPOUNDS IN LEACHATE FROM A WASTE TIP,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
J. Harmsen.
Water Resources, Vol. 17, No. 6, p 699-705, June, 1983. 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Leachates, *Organic compounds, *Waste dumps, Heavy metals, Amines, Alcohols, Hydrocarbons, Esters, Terpenes, Phthalates, Fermentation, Pollutant identification.

The first type of leachate was collected from a municipal waste dump (tip) in the acidification stage. The organic load of this leachate was high and consisted mainly of free volatile acids, over 95% of the total organic carbon (TOC). Volatile amines and ethanol were also present (0.8 and 0.7% of the TOC respectively). The leachate was extracted with hexane and the extract was analyzed with infrared and nuclear magnetic resonance spectroscopy and a gas chromatograph-mass spectrometer combination. In the extract alcohols, hydrocarbons, esters, terpenes and phthalates were identified. High molecular weight compounds were present only in a low concentration. The second type of leachate was collected from a waste dump in the methane fermentation stage. The organic load was relatively low. An important part of the organics was identified as high molecular weight compounds. About 32% of the organic carbon consisted of compounds with a molecular weight over 1000. Acids, amines and alcohols were not detected. The organic compounds present were end products of degradation processes. There was a remarkable difference in heavy metal content between the two types of leachate. During the acidification stage, metals are more soluble because of the lower pH and by complexation with the free volatile acids. In the methane fermentation stage, the acids dissappear, the pH rises and there is only a relatively small amount of organic compounds left, which results in a drastic fall in the metal concentrations, except for lead. (Moore-IVI)
W84-01682

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 1. GROUNDWATER FLOW AND PLUME DELINEATION,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
D. S. MacFarlane, J. A. Cherry, R. W. Gillham, and E. A. Sudicky.
Journal of Hydrology, Vol. 63, No. 1-2, p 1-29, May, 1983. 9 Fig, 1 Tab, 31 Ref.

Descriptors: *Pollutant migration, *Groundwater pollution, *Landfills, *Leachates, Chloride, Sulfate, Conductance, Water temperature, Water table mounding, Permeability coefficient, Groundwater movement, Plumes, Groundwater recharge, Mixing, Dispersion.

A landfill-derived contaminant plume with a maximum width of 600 m, a length of 700 m and a maximum depth of 20 m in an unconfined sand aquifer was delineated by means of a monitoring network that includes standpipe piezometers, multilevel point-samplers and bundle-piezometers. The extent of detectable contamination caused by the landfill, which began operation in 1940 and which became inactive in 1976, was determined from the distributions of chloride, sulfate and electrical conductance in the sand aquifer, all of which have levels in the leachate that are greatly above those in uncontaminated groundwater. The maximum temperature of groundwater in the zone of contamination beneath the landfill is 12 C, which is 4-5 C above background. The thermal plume in the aquifer extends 150 m downgradient from the center of the landfill. A slight transient water table mound exists beneath the landfill in the late spring and summer in response to snowmelt and heavy rainfall. Beneath the landfill, the zone of leachate contamination extends to the bottom of the aquifer, apparently because of transient downward components to hydraulic gradient caused by the water-table mound and possibly because of the higher density and lower viscosity of the contaminated water. Values of hydraulic conductivity, which show variations due to local heterogeneity, were obtained from slug tests of piezometers, from pumping tests and from laboratory tests. Because of the inherent uncertainty in the aquifer parameter values, the 38-yr. frontal position of the plume calculated using the Darcy equation with the assumption of plug flow can differ from the observed frontal position by many hundreds of meters, although the use of mean parameter values produces a close agreement. The width of the plume is large relative to the width of the landfill and can be accounted for primarily by variable periods of lateral east- and westward flow caused by changes in water-table configuration due to the variable nature of recharge. Northward from the landfill, the vertical thickness of the plume decreases and the top of the plume is farther below the water table. The thickness of the zone of uncontaminated water downflow from the landfill increases. Because dispersion in the vertical direction is weak, there is very little mixing between the overlying zone of recharge water and the contaminant plume. Concentration profiles are irregular beneath and near the landfill and become smooth downgradient where the maximum concentrations are much less than those beneath the landfill. These features are attributed to a strong influence of longitudinal dispersion. The plume passes beneath a small shallow stream near the landfill without significant influence on the stream. (Author's abstract)
W84-01684

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 2. GROUNDWATER MONITORING DEVICES,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. A. Cherry, R. W. Gillham, E. G. Anderson, and P. E. Johnson.
Journal of Hydrology, Vol. 63, No. 1-2, p 31-49, May, 1983. 5 Fig, 13 Ref.

Descriptors: *Groundwater pollution, *Monitoring, *Sampling, Plumes, Piezometers, Landfills, Leachates, Water quality, Water table, Sand aquifers, Networks.

Six types of devices for groundwater monitoring were used on an experimental basis in the investigation of the plume of contamination in the unconfined sandy aquifer at the Borden landfill. These include: standpipe piezometers, water-table standpipes, an augerhead sampler, suction-type and positive-displacement-type multilevel point-samplers, and bundle-piezometers. With the exception of the first two, each of these devices provides a means of obtaining vertical sample profiles of groundwater from a single borehole. The auger-head sampler, which is a device that is attached to the cutting head of conventional continuous-flight hollow-stem augers, yields samples from relatively undistributed aquifer zones as the augers are advanced downward in the borehole from one depth of sampling to another. This method is a rapid means of acquiring water-quality profiles for mapping the distribution of a contaminant plume. The other three profiling devices can be used to establish permanent networks for groundwater-quality monitoring. A suction-type multilevel sampler consists of twenty or more narrow polyethylene or polypropylene tubes contained in a PVC casing that is capped at the bottom. Each tube extends to a different depth and is attached to a small screened sampling point that extends through the casing to draw water from the aquifer when suction is applied. A positive-displacement multilevel sompler is similar except that each sampling point is connected to a positive-displacement pumping device located inside the PVC casing adjacent to the screen. Use of the suction-type multilevel sampler is limited to zones where the water table is less than the suction-lift depth of 8 or 9 m. The positive-displacement sampler can be used even if the water table is at a much greater depth. A bundle-piezometer consists of 1.2-cm O.D. flexible polyethylene tubes, each with a short screened section at the bottom, fastened as a bundle around a semi-rigid center-piezometer constructed of thick-walled 2-cm O.D. PVC pipe. In shallow water-table areas water is withdrawn from each of the tubes and from the PVC piezometer by suction. In areas with a deep water table, samples are obtained

by bailing with a narrow tube with a check valve on the bottom or by displacement using a double- or triple-tube gas-drive sampler. The positive-displacement multilevel sampler or use of the gas-drive samplers in the bundle-piezometers provide the best opportunities for collecting samples that can be filtered and have preservatives added without the water being influenced excessively. Networks of these three types of devices for multilevel groundwater monitoring were installed in the Borden aquifer of means of hollow-stem augers. The devices are particularly well suited for use in aquifers composed of cohesionless sand or gravel that have little or no clay and groundwater flow that is primarily horizontal. When 8-cm diameter hollow-stem augers are used, as many as eight polyethylene tubes are included conveniently in each bundle-piezometer. If augers with a large hollow-stem are used, more tubes can be assembled in each bundle. (Author's abstract)
W84-01685

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 3. TRITIUM AS AN INDICATOR OF DISPERSION AND RECHARGE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
B. C. E. Egboka, J. A. Cherry, R. N. Farvolden, and E. O. Frind.
Journal of Hydrology, Vol. 63, No. 1-2, p 51-80, May, 1983. 10 Fig, 34 Ref.

Descriptors: *Groundwater movement, *Tritium, *Tracers, Groundwater pollution, Plumes, Landfills, Leachate, Radioactive tracers, Chloride, Sulfate, Hydrodynamic dispersion, Precipitation, Mixing, Simulation.

Tritium serves as an identifier or tracer of post-1952 water in groundwater flow systems, because major atmospheric testing of nuclear weapons began in 1953. The distribution of 3H in and near the contaminant plume at the Borden landfill was determined by analysis of samples from multilevel point-samplers and from bundle-piezometers. The contaminant plume, which was delineated using Cl(-) and SO4(2-) patterns, was found to contain a large zone of tritiated water and a small zone with no detectable H3. Landfilling operations at the site began in 1940, and as the plume developed in the period from 1940 to 1952, any natural H3 that may have existed in the plume during this period is now below the detection level. During the years in the 1960's in which peak H3 concentrations occurred, values of thousands of tritium units (TU) in precipitation were common and levels of many hundreds of TU or higher existed almost continuously. In the zone of tritiated water in the plume and in the tritiated zone in the natural groundwater up- and downgradient of the plume, all of the sample points except three in the plume had concentrations below 150 TU. Two of these three have concentrations below 290 TU. The general occurrence in the aquifer of H3 levels that are much below the high levels that existed in precipitation prior to the 1970's is attributed to radioactive decay and to the effect of longitudinal hydrodynamic dispersion that has caused mixing of the tritiated groundwater with older untritiated water. Simulated H3 distributions using longitudinal dispersivity values in the range of 30-60 m gave H3 distributions similar to the field values. The strong longitudinal dispersion is believed to be caused by mixing between the ubiquitous layers of fine- and medium-grained sand and silty sand that comprise the aquifer. An estimate of the average annual rate of recharge that has contributed to the groundwater zone beneath the landfill during the bomb-tritium period was obtained by comparing the input of H3 to an area segment of the landfill with the H3 contained within a groundwater flow tube leading from the specified area along the centerline of the contaminant plume. This approach yielded a minimum average annual recharge rate of approximately 50%, with the main cause of uncertainty being the extent of the area in which recharge occurs. (Moore-IVI)
W84-01686

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 4. A NATURAL-GRADIENT DISPERSION TEST,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. A. Sudicky, J. A. Cherry, and E. O. Frind.
Journal of Hydrology, Vol. 63, No. 1-2, p 81-108, May, 1983. 15 Fig, 3 Tab, 26 Ref.

Descriptors: *Groundwater movement, *Tracers, *Dispersion, Landfill, Leachates, Chlorides, Path of pollutants, Groundwater pollution, Simulation, Hydraulic gradient.

A natural-gradient tracer test using a chloride solution with an initial injection volume of 0.7 cu m was performed in the sandy aquifer at the Borden site. The solution was injected into five well points set about 1 m below the water table in an uncontaminated zone situated above the contaminant plume at a location 450 m downflow from the landfill. Soon after injection, the tracer slug gradually split into two halves, one half moving horizontally at an average velocity of 0.0000029 m/s and the other horizontally at 0.00000082 m/s. Although the split has been attributed to local lateral heterogeneity, the nature of the heterogeneity and its influence on the hydraulic-head distribution were not clearly distinguishable in the field data obtained before, during and after the test. The chloride patterns for each of the two halves of the tracer slug evolved into Gaussian forms although the patterns demonstrated some irregularity at early time. The relatively smooth Gaussian forms were unexpected because the aquifer has numerous small-scale heterogeneities observed in vertical cores obtained from the tracer zone and because the glaciofluvial origin of the aquifer suggests that heterogeneities are not laterally continuous. Simulated chloride distributions from a three-dimensional analytical solution to the advection-dispersion equation were fitted to the field data to obtain best-fit estimates of the values of longitudinal, transverse-horizontal and transverse-vertical dispersivity at various travel distances for each of the two halves of the tracer zone. This is the first known field test that has permitted the estimation of three principal dispersion coefficients in layered media. The longitudinal dispersivity was found to increase from 0.01 m at a distance of 0.75 m from the source to 0.08 m at 11.0 m. The transverse-horizontal dispersivity increased also to a value of 0.03 m at 11.0 m. Transverse-vertical dispersion was very weak and was accounted for by molecular diffusion. The relative lack of vertical dispersion is consistent with the shape of the plume of leachate contamination from the landfill. The observed increase in dispersivity along the path of migration is likely caused by heterogeneities. (Moore-IVI)
W84-01687

MIGRATION OF CONTAMINANTS IN GROUNDWATER AT A LANDFILL: A CASE STUDY; 5. CATION MIGRATION IN THE DISPERSION TEST,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. T. Dance, and E. J. Reardon.
Journal of Hydrology, Vol. 63, No. 1-2, p 109-130, May, 1983. 12 Fig, 3 Tab, 16 Ref.

Descriptors: *Groundwater movement, *Tracers, *Path of pollutants, Calcium, Magnesium, Sodium, Potassium, Groundwater pollution, Landfill, Leachate, Model studies, Dispersion.

A shallow natural-gradient tracer test was conducted in an unconfined sandy aquifer at the Borden landfill site in June 1978. The tracer injected was a chloride solution containing approximately equimolar concentrations of the major cations at levels significantly above those in the background groundwater. Samples collected during monitoring of the tracer were analyzed for calcium, magnesium, sodium and potassium. The results showed an order of attenuation for major cations of K > Mg > Na. Ca, which was the dominant species on the exchange sites before injection of the tracer solution, was liberated during flow of the solution, resulting in the development of a calcium halo at the leading edge of the tracer solution. A one-dimensional mixing-cell model was used to simulate the results of the injection experiment. Both the field and model results show that the chemical composition of the background groundwater is changed due to exchange reactions as it flo
the path of the injection solution. These influ
continue until all the exchange sites along the
path re-equilibrate to their former pre-inj
values by the passage of background groundw
The migration of Na(+) in the flow syst
observed to closely parallel the movement of
although the maximum concentrations ar
creased over the concentration at inje
Mg(2+) migrates downflow at a rate slower
Cl(-), and at a much reduced concentration re
ing a strong tendency for sorption onto exc
sites. Both model and field results show
nounced K(+) attenuation during flow of th
jection solution. The bulk of the injected pota
was sorbed very close to the injection wells a
slowly liberated by interaction of backgr
groundwater following the passage of the inje
solution. (Moore-IVI)
W84-01688

**MIGRATION OF CONTAMINANTS
GROUNDWATER AT A LANDFILL: A C
STUDY; 6. HYDROGEOCHEMISTRY,**
Waterloo Univ. (Ontario). Dept. of Earth Scie
R. V. Nicholson, J. A. Cherry, and E. J. Rear
Journal of Hydrology, Vol. 63, No. 1-2, p 131
May, 1983. 18 Fig, 5 Tab, 66 Ref.

Descriptors: *Groundwater pollution, *Gro
water movement, Landfills, Leachates, Plu
Calcium, Sulfates, Iron, Bicarbonates, Water
ity, Calcite, Heavy metals, Organic carbon, P
sium, Magnesium, Sodium, Path of pollutants.

Multilevel point-samplers located on a longitu
cross-section through the plume of contami
groundwater in the sand aquifer at the aband
Borden landfill were used to obtain a suit
small-volume samples for analysis of major
and of minor and trace-level inorganic con
ents. Calcium is the dominant cation and su
and biocarbonate are the dominant anions in
contaminant plume, with maximum concentra
of 400, 2000 and 1200 mg/l, respectively. Ben
the landfill the most highly contaminated wat
the aquifer has total dissolved solids of 4000 m
Sulfate and iron are the only inorganic constitu
that exceed the recommended limits for drin
water. The plume contains above-background
centrations of dissolved zinc and manganese.
heavy metals or other hazardous inorganic t
elements occur at levels above the maximum li
for drinking water. The plume contains level
total dissolved organic carbon that are above b
ground levels, ranging from 30 mg/l beneath
landfill to 5 mg/l near the front of the plu
Calcite dissolution is the origin of much of
dissolved inorganic carbon and some of the
cium in the plume. Most of the sulfate and muc
the calcium in the plume appears to be der
from gypsum in construction debris in the land
Some of the dissolved iron in the plume re
from the release under reducing conditions of
from ferric iron coatings on sand grains locate
the aquifer beneath the landfill and in the layer
the refuse. Dissolved sulfide is present at only v
low concentrations and is probably controlled
ferrous sulfide solubility. Exchange of cations
tween the aquifer material and the leachate-c
taminated groundwater is an apparent cause
calcium release and subsequent precipitation
calcite in the plume. As much of 80% of the K(
20% of the Mg(2+) and 15% of the Na(+) in
plume exists on the exchange sites. (Moore-I
W84-01689

**MIGRATION OF CONTAMINANTS
GROUNDWATER AT A LANDFILL: A CA
STUDY; 7. DC, VLF, AND INDUCTIVE RES
TIVITY SURVEYS,**
Waterloo Univ. (Ontario). Dept. of Earth Scien
J. P. Greenhouse, and R. D. Harris.
Journal of Hydrology, Vol. 63, No. 1-2, p 177-1
May, 1983. 9 Fig, 19 Ref.

Descriptors: *Groundwater pollution, *Landfi
*Path of pollutants, *Resistivity, Groundwa
movement, Geophysics, Model studies, Leacha
Geohydrology.

current (DC), very-low-frequency (VLF) luctive resistivity surveys of the abandoned at Canadian Forces Base Borden were un- n initially to assist in mapping the migration taminants and continued to assess the rela- fulness of the three techniques for the task. ee techniques were successful in outlining gions of highest landfill-derived dissolved ients in the sand aquifer, but the electro- ic methods have a significant advantage C resistivity in both resolution and cost. nclusion is very site-specific; it is important uate geophysical methods through prelimi- odelling before undertaking field work at a e. Where the contaminant levels at Borden than about twice background, mapping stribution with surface geophysics became le. Surface surveys are ultimately limited usefulness by natural scatter in the appar- stivity, variations which are unrelated to ations in contaminant level. This lithologi- topographical 'noise' can easily mask the f a contaminant pattern and is generally ble from contaminant-related variations. If ical monitoring is to be useful, it is essen- resistivity surveys be undertaken as part of landfill hydrogeological studies in order to the natural scatter from post-landfill sur- loore-IVI)
690

IMENTAL INVESTIGATIONS OF UN- NED AQUIFER POLLUTION FROM RGE BASINS,
Energy of Canada Ltd., Pinawa (Manito-

nasen, and R. E. Volker.
Resources Research, Vol. 19 No. 3, p 707- e, 1983. 21 Fig, 1 Tab, 19 Ref.

ors: *Groundwater pollution, *Aquifers, water recharge, Model studies, Mathemat- dels, Computer models, Recharge rate, Velocity.

ents in a sand-filled flume simulate con- movement in an unconfined aquifer from trip recharge basin. Sodium chloride is a tracer with its distribution being moni- ia electrical conductivity measurements d and stored through a minicomputer. cts of initial saturated depth and magni- the recharge rate on the pattern of con- movement can be considered in two The first phase involves vertical mixing e basin, while the second involves hori- ovement and mixing away from the re- one. The initial aquifer depth has a signifi- uence on the thickness of the mixing zone as on the inclination of the contaminant he horizontal direction. Comparisons with om numerical models are provided for the movement of the contaminant front and ness of the mixing zone as well as for the e free surface level. (Moore-IVI)
13

C ANALYSIS OF STRONTIUM AND IUM SORPTION ONTO SANDS AND S IN A NATURAL CHANNEL,
al Survey, Menlo Park, CA.
ary bibliographic entry see Field 2K.
15

TION OF SOLUTE TRANSPORT IN A AIN POOL-AND-RIFFLE STREAM KINETIC MASS TRANSFER MODEL RPTION,
al Survey, Menlo Park, CA.
ary bibliographic entry see Field 2K.
16

YING SOURCES OF GROUND- POLLUTION: AN OPTIMIZATION CH,
al Survey, Menlo Park, CA.
relick, B. Evans, and I. Remson.
sources Research, Vol. 19, No. 3, p 779- , 1983. 6 Fig, 9 Tab, 28 Ref. NSF grant 8943.

Descriptors: *Groundwater pollution, *Water pollution sources, *Solute transport, Simulation, Linear programming, Least squares regression, Error analysis, Model studies, Solute transport, Leakage.

Least squares regression and linear programming for least absolute error estimation are each combined with groundwater solute transport simulation to identify the locations and magnitudes of aquifer pollutant sources. Pollutant sources are identified by matching simulated and measured nonreacting solute concentration data. Known hydraulic parameters are assumed, but concentration data errors are considered explicitly. The identification models are demonstrated and compared using two hypothetical aquifer systems, one for the steady state case and the other for the transient case. Steady state models identified unknown pipe leak locations and the leak magnitudes based upon sparse and spatially distributed chloride and tritium data. The number of likely leak locations was restricted in the models by employing mixed integer programming and stepwise multiple regression. Transient models identified several annual disposal fluxes in the aquifer based upon concentration histories collected at observation wells. Conservative solute concentration data were abundant and contained substantial errors. Minimizing either least absolute or least squared errors was successful in identifying pollutant sources. Error analysis is demonstrated for the results given by either method. (Moore-IVI)
W84-01721

EFFICIENT FINITE ELEMENT TECHNIQUE FOR MODELING TRANSPORT IN FRACTURED POROUS MEDIA; 1. SINGLE SPECIES TRANSPORT,
GeoTrans, Inc., Reston, VA.
For primary bibliographic entry see Field 2F.
W84-01726

ON THE BEHAVIOR OF ENVIRONMENTAL POLLUTANTS IN ARTIFICIAL AQUIFERS (ZUM VERHALTEN VON UMWELTCHEMIKALIEN IN KUNSTLICHEN GRUNDWASSERGERINNEN),
V. Betz, G. Fischer, H. Gorbauch, H. H. Rump, and B. Scholz.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 315, No. 5, p 464-474, July, 1983. 10 Fig, 6 Tab, 14 Ref.

Descriptors: *Groundwater pollution, *Path of pollutants, Landfills, Leachates, Water pollution sources, Simazine, Lindane, Trichloroethane, Tetrachloroethane, Aquifers.

Selected chemical substances (simazine, lindane, tri-, tetrachloroethene) were fed into an artificial aquifer (100 m) operated with diluted seepage water from an aerobic landfill. Numerous sampling points made it possible to obtain more information about a three-dimensional distribution of the substances within the aquifer. Elimination and retention can be observed as well. Problems of sampling and analytical procedures are discussed. It was obvious that the methods of sampling and determination required certain adaptions because of the difficult local conditions and the complex matrix composition, respectively. The work was carried out within the scope of an interdisciplinary research program. (Author's abstract)
W84-01734

SLAKING MODES OF GEOLOGIC MATERIALS AND THEIR IMPACT ON EMBANKMENT STABILIZATION,
E. F. Perry, and D. E. Andrews.
Transportation Research Record, Vol. 873, p 22-28, 1982. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Mine wastes, *Spoil banks, *Slaking, Infiltration, Sheet erosion, Water pollution sources, Appalachian Basin.

The results of a study of the impacts of slaking on surface mine spoils in the Appalachian Basin are discussed. Representative samples were collected for laboratory analyses from core borings near the active highwall and from test pits excavated in fresh and 2-, 5-, and 10-year-old spoils from four selected mine sites. Extensive qualitative and semiquantitative data were collected on the behavior, causes, and effect of slaking materials. Three slaking models were identified in the field: (a) slaking to constituent grain size; (b) chip slaking to thin, platy fragments; and (c) slab or block slaking to large, approximately equidimensional fragments. These modes are dependent on inherent material properties such as bedding, cementation, and grain size and may affect overall spoil pile or embankment stability. Slaking to inherent grain size promoted surface crusting, reducing infiltration and accelerating sheet erosion. Stability problems in embankments and spoil piles can be anticipated by observing the rate, degree, and modes of slaking. (Author's abstract)
W84-01759

DYNAMIC ADVECTIVE WATER QUALITY MODEL FOR RIVERS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
K. W. Bedford, R. M. Sykes, and C. Libicki.
Journal of Environmental Engineering, Vol. 109, No. 3, p 535-554, June, 1983. 5 Fig, 2 Tab, 34 Ref.

Descriptors: *Water quality, *Storm runoff, *Mathematical models, Hydrodynamics, Plankton, Sedimentation, Diffusion, Light effects, Turbulence, Biochemical oxygen demand, Nitrogen, Orthophosphate, Olentangy River, Ohio.

A dynamic water quality model for storm induced flows in rivers is presented. The hydrodynamic portion is solved by a four-point implicit Newton-Raphson procedure, while the water quality code is formulated with a Holley-Preissmann nonlinear formulation. The water quality model represents the effects of biodegradation by plankton, sedimentation, and diffusion of material into the benthos by a single turbulence dependent decay term. Eight constituents are employed and the effects of light shading are considered. Two simple tests were used to provide simple initial calibrations. The first test, the propagation of a Gaussian wave, demonstrated the necessity of higher order treatment of the water quality numerical analog. The second test was a steady state test of the water quality model against data from the Olentangy River. The minimum kinetic structure required for Ohio streams should include CBOD, organic nitrogen, ammonia nitrigen, nitrate nitrogen, and orthophosphate. (Author's abstract)
W84-01767

ACID RAIN MODEL: CANOPY MODULE,
Tetra Tech, Inc., Lafayette, CA.
C. W. Chen, R. J. M. Hudson, S. A. Gherini, J. D. Dean, and R. A. Goldstein.
Journal of Environmental Engineering, Vol. 109, No. 3, p 585-603, June, 1983. 4 Fig, 7 Tab, 31 Ref.

Descriptors: *Acid rain, *Canopy, *Water pollution sources, Throughfall, Dry deposition, Forest watersheds, Nitrification, Oxidation, Acidity, Particulates, Air quality, Woods Lake, New York.

As a part of the Integrated Lake-watershed Acidification Study, and acid rain model is being developed to provide quantitative linkage between acid deposition and lake acidification. A canopy model has been developed to calculate throughfall characteristics based on canopy properties, ambient air quality, and precipitation quantity and quality. The processes considered include wet and dry deposition, leaf exudation, nitrification, and oxidation of SO2 and NOx. The canopy model requires only standard input data that can be obtained by use of rain gages, thermometers, dry and wet collectors. The model has been calibrated with data collected at Woods Lake in the Adirondack Mountains of New York. The model has accurately simulated throughfall volume and the concentration of 15 throughfall chemical constituents. Ammonium, NH4(+) accumulated on the canopy is nitrified rapidly, resulting in an increase in acidity and nitrate fluxes. The dominant process occurring in

the coniferous canopy is dry deposition. Calculations suggest that dry deposition measured by bulk collectors grossly underestimates the total amount of dry deposition to the forested watershed. The enrichment of acidity in coniferous throughfall is derived primarily from the accumulation of acidic air particulates. The dominant process occurring in the deciduous canopy is exudation. This partially neutralizes the acidic deposition. (Moore-IVI)
W84-01769

5C. Effects Of Pollution

EFFECTS OF CRUDE OIL AND NAPHTHALENE ON GROWTH, CALORIC CONTENT, AND FAT CONTENT OF PINK SALMON JUVENILES IN SEAWATER,
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
A. Moles, and S. D. Rice.
Transactions of the American Fisheries Society, Vol. 112, No. 2A, p 205-211, March, 1983. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Salmon, *Toxicity, *Oil, *Hydrocarbons, Growth, Juvenile growth stages, Naphthalene, Water pollution effects.

Juvenile pink salmon Oncorhynchus gorbuscha were exposed for 40 days to stable, sublethal concentrations of naphthalene (<0.80 mg/liter) and the water-soluble fraction of Cook Inlet crude oil (<0.87 mg/liter total aromatic hydrocarbons). All fish were fed equal daily rations of Oregon Moist Pellet Formula II. Concentrations (percentage of the 96-hour LC50, median lethal concentration) of 10% naphthalene and 14% water-soluble fraction of crude oil did not affect wet weight or length of exposed fish. At higher concentrations, however, growth per day determined from wet weight decreased with increased toxicant concentrations. Change in length of the fish was not a sensitive measure of toxicity. Fish exposed for 40 days to concentrations of toxicants as low as 33% of the 96-hour LC50 weighed significantly less than control fish ($P<0.05$). Juveniles exposed to the water-soluble fraction of crude oil had slower growth rates than those exposed to the same concentration (percentage of the LC50) of naphthalene. Fish exposed to either naphthalene or the the water-soluble fraction of crude oil had decreased caloric content; however, fat content of the fish was not affected. Chronic marine oil pollution at a concentration as low as 0.40 mg/liter total aromatic hydrocarbons could reduce growth of juvenile pink salmon. (Author's abstract)
W84-01403

SIMULATION OF STRIPED BASS EGG AND LARVA DEVELOPMENT BASED ON TEMPERATURE,
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
J. Boreman.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 286-292, March, 1983. 4 Fig, 1 Tab, 23 Ref.

Descriptors: *Water temperature, *Bass, Fish eggs, Larvae, Mortality, Simulation, Growth, Mathematical models, Hudson River.

Comparisons of simulated and observed egg and larva abundance patterns for Hudson River striped bass Morone saxatilis during 1975 and 1976 provided support for a previously stated hypothesis that a sudden drop in water temperature during late May 1976 was associated with almost complete disappearance of cohorts spawned before that date. The major period of mortality for the earlier-spawned cohorts may have occurred during or immediately following egg hatching rather than immediately following yolk absorption as had been previously postulated. (Author's abstract)
W84-01407

COMPARATIVE TEMPERATURE-DEPENDENT GROWTH RATES OF LARGEMOUTH AND SMALLMOUTH BASS FRY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. C. Coutant, and D. L. DeAngelis.
Transactions of the American Fisheries Society, Vol. 112, No. 3, p 416-423, May, 1983. 2 Fig, 1 Tab, 20 Ref. W-7405-eng-26.

Descriptors: *Bass, *Growth, *Water temperature, Juvenile growth stages, Predation.

First-month growth was temperature-dependent for fry of largemouth bass Micropterus salmoides and smallmouth bass M. dolomieui that were raised simultaneously under identical conditions. Similar temperatures (25-27 C) produced the fastest growth rates in both species, although largemouth bass grew most rapidly at the higher end of this range. Largemouth bass generally grew faster than smallmouth bass, particularly in the 25 to 30 C range (average 1.4 times). Variance about the mean standard length increased at higher temperatures. Differing temperature-dependent growth rates and size distributions for the two species may influence their relative abilities to survive predation and to form strong year classes in temperature regimes that differ due to latitude or weather. (Author's abstract)
W84-01416

RELATIONSHIP BETWEEN OPTIMUM TEMPERATURES FOR GROWTH AND PREFERRED TEMPERATURES FOR THE YOUNG OF FOUR FISH SPECIES,
Ecological Analysts, Inc., Sparks, MD.
R. L. Kellogg, and J. J. Gift.
Transactions of the American Fisheries Society, Vol. 112, No. 3, p 424-430, May, 1983. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Fish behavior, *Water temperature, *Growth, Bass, Perch, Catfish, Shiner, Thermoregulation.

Optimum temperatures for growth and temperature preference were estimated and compared for young striped bass Morone saxatilis, white perch Morone americana, white catfish Ictalurus catus, and spottail shiner Notropis hudsonius to determine how closely behavioral thermoregulation corresponded to optimal growth temperatures. Differences between the final preferenda and the optimum growth temperatures were less than 2 C. The percentage of preferred temperatures that were within the temperature range corresponding to 75-100% of maximum growth was 76-100%. Only a small percentage (0.17%) of preferred temperatures were greater than the upper limit of the range supporting 75% or more of maximum growth, indicating that fish were avoiding temperatures that were suboptimal for prolonged exposures. (Author's abstract)
W84-01417

TOXICITY OF TEXAN PETROLEUM WELL BRINE TO THE SHEEPSHEAD MINNOW (CYPRINODON VARIEGATUS), A COMMON ESTUARINE FISH,
Fish and Wildlife Service, Victoria, TX.
J. K. Andreasen, and R. W. Spears.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 3, p 277-283, March, 1983. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Environmental effects, *Brines, Water pollution effects, Saline water, Industrial wastes, Oil industry, Fish, Toxicity, Minnows, Estuaries.

A series of tests was conducted including tolerance testing with artificial sea salts and with petroleum brine in two different dilution waters. The 96 hr LC50 for sheepshead minnows exposed to artificial seasalt was 60 0/00. The 96 hr LC50 for petroleum brine diluted with deionized water was 35 0/00. This salinity occurred when the test water consisted of about 55% brine. For brine diluted with seawater the LC50 was 52 0/00 or 60% dilution. Analysis of test water showed that concentrations of calcium and manganese were much higher and the concentrations of sulfate was lower in petroleum brine diluted with either deionized water or seawater than in normal seawater. While s
head minnows are hardy in their tolerance o
ity, petroleum brine differs from normal se
in the relative concentration of various ion
results of these tests showed that laboratory
leum brines are acutely toxic to sheepshea
nows when diluted about 40% with seawate
salinity of 52 0/00. Petroleum brine mixed
with seawater to a salinity of 37 0/00 was a
toxic to white and brown shrimp. The toxic
petroleum brine in a natural situation is deter
by the amount of brine being discharged, th
ciency of the brine/oil separator, the volume
receiving water, and the rate at which mixin
exchange take place. Reductions in the fresh
inflow to Texas estuaries or increases in
discharge will increase the probability of
conditions being created in some estuarine sy
(Baker-IVI)
W84-01420

A SIMPLE TOXICITY APPARATUS FOR
TINUOUS FLOW WITH SMALL VOLU
DEMONSTRATION WITH MYSIDS
NAPHTHALENE,
Lehigh Univ., Bethlehem, PA. Dept. of Bio
For primary bibliographic entry see Field 7B.
W84-01424

HEAVY METAL CONCENTRATIONS IN
SUES OF VIRGINIA RIVER OTTERS,
Virginia Polytechnic Inst. and State Univ., Bl
burg. Dept. of Fisheries and Wildlife Scie
K. L. Anderson-Bledsoe, and P. F. Scanlon.
Bulletin of Environmental Contamination
Toxicology, Vol. 30, No. 1, p 442- 447,
1983. 1 Tab, 14 Ref.

*Water pollution effects, *Otters, *Heavy m
Metals, Roanoke, Virginia, Accumulation,
Cadmium.

Tissue concentrations of heavy metals in
trapped in Virginia were studied. Median co
trations of lead and cadmium found in the
tissues were considered to be well below
concentrations and mean lead concentrations
similar to those found in Canada geese and
lards without evidence of ingested lead shot.
concentration of lead in bone is indicativ
chronic exposure to lead since bone is the pri
long term storage site for lead. The highest
centrations of lead found in river otters we
bone samples from 1980-1981 though median
centrations were relatively low. Mean conce
tions of lead and cadmium were similar to
concentrations found in whole body sample
small mammals trapped near roadways of low
fic densities but were higher than those in s
animals trapped in control areas. River otters
possibly be adversely affected by the comb
effects of those concentrations of cadmium
lead present in fish species and in sediments w
otters probably ingest with food. Median con
trations of lead and cadmium in sediment sam
taken at three stations located relative to a hea
travelled highway of Back Creek near Roan
Virginia ranged from 4.9 to 8.1 microgram/g
weight and 0.02 to 0.04 microgram/g dry we
(Baker-IVI)
W84-01426

BEHAVIORAL RESPONSE OF MALLARDS
CONTAMINATED DRINKING WATER,
Michigan State Univ., East Lansing. Dept. of F
eries and Wildlife.
B. L. Rowe, and H. H. Prince.
Bulletin of Environmental Contamination
Toxicology, Vol. 30, No. 5, p 505-510, May, 19
1 Fig, 1 Tab, 14 Ref.

*Behavior, *Water birds, *Drinking water, Wa
pollution effects, Birds, Ducks, Water pollut
effects, Avoidance response, Hydroquino
Copper sulfate, Simazine, Organic compounds.

Male gamefarm mallards were housed in individ
compartments with temperatures varying from
to 26 C. Water consumption was measured for

en a choice between distilled water and
vater containing one of three concentra-
ıydroquinone, copper sulfate or simazine
percent active ingredient. Each chemical
ed for a 15 day treatment period which
a 10 day acclimation period. Treatment
consisted of 100, 500 or 1000 ppm hydro-
30, 60, and 100 ppm copper sulfate, or 5,
) ppm simazine. Mallards drank an aver-
3 g of water per day during the treatment
/hen offered copper sulfate treated water
m, the mallards shifted their consumption
the treated water supply. Hydroquinone
vater was avoided. Ducks given copper
eated water were undergoing prebasic
ch may have influenced their response as
eds increase during molt and trace miner-
ements may arise. Results of the study
ply that waterbirds may be able to avoid
water systems even at low non-toxic
contamination. (Baker-IVI)
0

ATION OF CHANNEL CATFISH (IC-
S PUNCTATUS) TO NITRATE,
ker, and T. E. Schwedler.
of Environmental Contamination and
gy, Vol. 30, No. 5, p 516-521, May, 1983.

Nitrates, *Acclimatization, Methemoglo-
sh, Channel catfish, Water quality, Water
effects, Lakes, Ponds, Fish behavior, Fish
Fish stocking, Chlorides.

bility that channel catfish can acclimate
was studied. In tests with fish that had
ously been exposed to more than 0.01
fish developed higher levels of methe-
than fish with an immediate past history
re to relatively high NO2(-)/Cl(-) ratios.
el catfish fingerlings (45 g average
ot previously exposed, the percent meth-
ı decreased during the study period as
);Cl(-) molar ratio decreased. Within one
being stocked into a pond containing
0 fingerlings that had been exposed to
ncentrations than 3.0 mg/l NO2(-)-N for
ıe preceding two weeks and where the
inity was 277 mg/liter as CaCO3, methe-
values had increased to 56%. For at least
the unacclimated fish has percent methe-
values more than twice as high as accli-
ı, with levels not decreasing to compara-
until 15 days after stocking. In another
t, the mean methemoglobin in fish re-
single dose of 3.28 mg/l NO2(-)-N was
h higher than the predicted value of 39%
globin. The findings could have implica-
both research and commercial culture
agement. In west central Mississippi ni-
uced methemoglobinemia is currently
by adding a chloride salt to decrease the
(-) molar ratio to 0.25. This results in
globin levels between 25 and 30%, and is
to prevent death of fish in the pond.
if the pond is stocked with fish previous-
sed to high NO2(-)/Cl(-) molar ratios the
ish may develop methemoglobin levels
her than the indigenous population and
ing severe methemoglobinemia in the
sh may result in death or stress, particu-
solved oxygen levels are marginally low.
I)
1

ATHOLOGIC EFFECTS OF JP-4 AVI-
UEL ON FATHEAD MINNOWS (PI-
ES PROMELAS),
e Aerospace Medical Research Lab.,
tterson AFB, OH.
ndresse II, and J. W. Fisher.
of Environmental Contamination and
y, Vol. 30, No. 5, p 536-543, May, 1983.
ab, 10 Ref.

oxicity, *Fuel, Hydrocarbons, Oil indus-
pollution effects, Minnows.

ninnows were used to determine which
l organs were affected by acute exposure to the water soluble fraction (WSF) of JP-4, an aviation fuel derived from petroleum. The only lesions strongly implicated as being caused by exposure to WSF JP-4 were degeneration and necrosis of segments of the mucosa covering the olfactory rosette. A low incidence of cellular alterations was found in the pseudobranch and gill of exposed fish suggesting possible toxicant related effect. Degeneration and necrosis of the nasal mucosa were absent in the control and 10 dose groups, but were present in 50% of the group exposed to 10 mg/l WSF JP-4 and these lesions were seen in high-dose subjects as early as six hours after exposure. Affected segments of the mucosa often appeared only slightly thickened. Focal cellular alterations were noted in acidophilic cells of the pseudobranch in about 1/4 of the fish exposed to 5 and 10 mg/l WSF JP-4. These alterations included acute cellular swelling, cytoplasmic vacuolization, and cytoplasmic inclusions. Other microscopic observations of low incidence in control and exposed fish that were not considered to be related included the following: choroiditis of the eye, granulomatous thyjitis, and hepatocellular cytoplasmic vacuolar changes. (Baker-IVI)
W84-01434

EFFECT OF CALCIUM AND ALUMINUM CONCENTRATIONS ON THE SURVIVAL OF BROWN TROUT (SALMO TRUTTA) AT LOW PH,
Central Electricity Generating Board, Ratcliffe-on-Soar (England). Freshwater Biology Unit.
D. J. A. Brown.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 5, p 582-587, May, 1983.

*Calcium, *Aluminum, *Trout, *Survival, Acidity, Fish, Water pollution effects, Toxicity.

Survival times of yolk sac fry of brown trout were determined at various levels of pH and at different concentrations of calcium and aluminum solutions. In the absence of aluminum, mortalities occurred at pH 4.5 only with 0.25 and 0.5 mg/l of calcium. In solutions containing 0.25 mg/l of aluminum, however, a complete range of responses was noted, from no or very low survival with 0.5 mg/l calcium to almost complete survival with 2.0 mg/l of calcium. Solutions containing 0.5 mg/l of aluminum lead to almost complete mortalities with calcium concentrations of 0.25 and 0.5 mg/l and still significant mortalities at higher calcium concentrations. There is a tendence for higher pHs to be more toxic especially in solutions containing 0.5 mg/l of aluminum. Overall one of the most striking results was the difference between the numbers surviving in solutions containing 0.5 mg/l of calcium and less when compared with those in 1.0 mg/l of calcium or more. It would appear that although the relationship between calcium and aluminum in determining the fishery status of low pH lakes is complex, both ions will need to be considered in any attempt to explain the field observatons. (Baker-IVI)
W84-01437

SURVIVAL AND CONDITION OF RAINBOW TROUT (SALMO GAIRDNERI) AFTER EXPOSURES TO METHYL PARATHION, TRIPHENYL PHOSPHATE, AND DEF,
Fish and Wildlife Service, Columbia, MO.
D. Palawski, D. R. Buckler, and F. L. Mayer.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 5, p 614-620, May, 1983. 3 Tab, 11 Ref.

*Organophosphates, *Fish, *Survival, Agricultural chemicals, Defoliants, Pesticides, Hydraulic fluids, Methyl parathion, DEF, Triphenyl phosphate, Toxicity.

Toxicity data was sought for DEF, an aliphatic organophosphate defoliant; methyl parathion, an aliphatic/aromatic organophosphate insecticide; and triphenyl phosphate, an aromatic organophosphtae combined with various phosphate esters in mixtures to form hydraulic fluids. The protocol used for this study was also evaluated for possible use in assessing the effects of chemical spills on aquatic resources. One hundred fish were exposed under static water conditions for 96 hr to each toxicant in 30-liter stainless steel tanks. After the 96 hr exposure, a maximum of 40 survivors per exposure were removed from the tanks, stocked in 45 liter stainless steel tanks and reacclimated to clean well water. The 96-hr LC50s were 0.36 mg/l for triphenyl phosphate; 0.31 mg/l for DEF; and 2.8 mg/l for methyl parathion. Results obtained after 96 hr of static exposure indicated that methyl parathion at concentrations of 2.1, 2.4, and 2.8 mh/l produced the most deleterious effects to rainbow trout, causing mortalities of 37%, 38%, and 61% respectively. All survivors in each concentration were immobile and had distended abdomens at the end of the static exposure. Ability of survivors to recover after exposure to methyl parathion was significantly impaired during the first day after transfer to clean water. After this critical period no further mortality was noted. Survival after exposure was 28% for fish exposed to 2.1 mg/l of methyl parathion, but only 2% for fish exposed to 2.8 mg/l. No significant increase was noted in mortality of rainbow trout during the observation period following exposure to triphenyl phosphate. A biological effect noted in about 12% of the survivors exposed to the highest concentration of triphenyl phosphate was possible vertebral damage in the caudal area, resulting in spinal curvatures. (Baker-IVI)
W84-01438

SHORT-TERM STANDING CROP AND DIVERSITY OF PERIPHYTIC DIATOMS IN A EUTROPHIC RESERVOIR,
K. D. Hoagland.
Journal of Phycology, Vol. 19, No. 1, p 30-38, March, 1983. 7 Fig, 6 Tab, 62 Ref. 14-34-0001-6028.

Descriptors: *Diatoms, *Standing crops, *Species diversity, Periphyton, Weather, Turbulence, Substrates, Attachment, Wave action, Colonization, Eutrophication, Reservoirs.

Adverse weather and resultant turbulence caused sloughing of attached diatom communities during the first two weeks of colonization on artificial substrates. In contrast to Pacific macroalgal systems, older communities (8-12 d) were the most affected by wave action. Ash-free dry weight of the periphyton and diatom cell density generally increased, except following periods of high turbulence when losses of up to 80% occurred. The maximum cell density (400,000 diatoms/sq cm) and ash-free dry weight (2.9 mg/sq cm) are among the highest reported for similar conditions. Percent transmittance through the growth layer correlated significantly with cell density and ash-free dry weight and is recommended as a rapid method for measuring the relative accumulation of periphyton. Diatom diversity generally increased throughout the study period and did not clearly reflect the effects of disturbance as did standing crop. Comparisons of diatom diversity and community composition indicated that the three overlapping growth series were not significantly different and samples collected on the same date were not more similar than those of identical age. Combined with previous evidence, the present study indicates that the first two weeks of substrate exposure in the summer represented a colonization phase followed by rapid microsuccession. (Author's abstract)
W84-01446

DISTRIBUTION OF HEMICELLULOSE-DECOMPOSING BACTERIA AND ENVIRONMENTAL CONDITIONS IN SEAWATER IN HIRO BAY,
Shimonoseki Univ. of Fisheries (Japan). Lab. of Microbiology.
M. Murakami, and H. Fujisawa.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 49, No. 3, p 455-462, March, 1983. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Pulp wastes, *Microbial degradation, *Hemicellulose, Heterotrophic bacteria, Effluent, Water pollution effects, Kraft mills, Seawater, Chemical oxygen demand, Marine environment, Hiro Bay, Japan.

On the coast of Hiro Bay in Seto Inland Sea, there is a kraft pulp mill whose effluent flows into the bay. Many workers have reported about organic pollutants and their influence on fishery in this area. Although microbiological work is indispensable for clarifying the mechanism of the decomposition of organic pollutants, little has been known about it. Therefore, a series of studies has been undertaken to clarify the microbial decomposition of hemicellulose in coastal waters polluted with pulp mill effluent. The distribution of heterotrophic bacteria and hemicellulose decomposing bacteria, and the environmental conditions of seawater in the above-mentioned area were investigated five times from 1979 to 1981. The results obtained can be summarized as follows: the population densities of heterotrophic bacteria, glucomannan-decomposing bacteria, xylan-decomposing bacteria and agar-decomposing bacteria per ml of seawater, were 100 to 10,000,000, 10 to 100,000, 10 to 10,000,000 and 10 to 100,000 respectively. The significance test of common coefficient regression analysis in the 1 m layer of seawater showed that the population density of bacteria and the value of COD decreased with the distance from pulp mill. The ratio of the population density of xylan-decomposing bacteria to the population density of heterotrophic bacteria in the 1 m layer of seawater was 10 to 1,000 times as high as that in the control area (Yoshimi Bay), and similar to that in other pulp mill polluted areas (Iwakuni waters). Therefore, it can be said that this ratio may be one of the suitable indices for the pollution from pulp mills. (Author's abstract)
W84-01455

A MODEL FOR THE DENSITY OF AEROMONAS HYDROPHILA IN ALBEMARLE SOUND, NORTH CAROLINA,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
T. C. Hazen.
Microbial Ecology, Vol. 9, No. 2, p 137-153, July, 1983. 8 Fig, 6 Tab, 35 Ref. RR-8102, 04F15844030, DE-AS09-76EY-0900.

Descriptors: *Aeromonas, *Mathematical models, *Water quality, Heterotrophic bacteria, Coliforms,Dissolved oxygen, Water temperature, Orthophosphate, Chlorophyll a, Kjeldahl nitrogen, Ammonia, Regression analysis, Epizootiology, Eutrophication, Reservoirs, Estuaries.

The abundance of Aeromonas hydrophila was measured monthly at 29 sites in Albemarle Sound, North Carolina and its tributaries from April 1977 through July 1979. Simultaneous measurements included heterotrophic plate count bacteria, fecal coliform bacteria, and 18 physical and chemical parameters. Using only 6 water quality parameters, multiple correlation and regression analysis of the data produced a best-fit regression which explained 38% of the variation observed in A. hydrophila density. The 6 water quality parameters included dissolved oxygen, temperature, orthophosphate, chlorophyll A trichromatic, total Kjeldahl nitrogen, and ammonia. Heterotrophic plate count bacteria and fecal coliform densities were highly correlated with A. hydrophila density, but made the model very unstable. The model was successfully tested against similar data collected for 2 other North Carolina reservoirs, Lake Norman and Badin Lake. Data from 10 sites in Badin Lake over 18 months and from 7 sites on Lake Norman over 5 months were not significantly different from the Albemarle Sound model. Conditions of water quality that may give rise to 'blooms' of A. hydrophila will simultaneously contribute to the probability of increased epizootics in fish in the southeastern United States. (Author's abstract)
W84-01473

CHANGES IN WATER AND SEDIMENT BACTERIAL COMMUNITY STRUCTURE IN A LAKE RECEIVING ACID MINE DRAINAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
R. A. Wassel, and A. L. Mills.
Microbial Ecology, Vol. 9, No. 2, p 155-169, July, 1983. 2 Fig, 5 Tab, 39 Ref. DEB-7906298.

Descriptors: *Acid mine drainage, *Bacteria, *Water pollution effects, Biological communities, Heterotrophic bacteria, Heavy metals, Sediment bacteria, Species diversity.

Water and sediment bacterial communities in a freshwater impoundment were studied over a 13-month period for stress-related responses to a point source of acid mine drainage (AMD). Comparisons of community structure were made on collections taken at the mouth of the acid stream, at a point 2 km downstream, and at the mouth of an uncontaminated stream. Monthly measurements of pH and specific conductance indicated the expected decrease in the AMD pollution with increasing distance from the source. Acridine orange direct counts did not differ significantly among the sites; however significantly fewer viable heterotrophs were observed by plate counts at the acid impacted station relative to the uncontaminated site. The diversity of the communities was significantly lower at the sites receiving mine drainage as compared with the unaffected station, and comparisons of community similarity showed that collections from the impacted sites were more like each other than like the control site. The assemblage at the latter site contained many bacterial guilds not found at the contaminated sites. The guilds unique to the control site showed a reduced in vitro ability to tolerate heavy metals as compared with the general community. (Author's abstract)
W84-01474

INVESTIGATIONS ON THE INFLUENCE OF COASTAL UPWELLING AND POLLUTED RIVERS ON THE MICROFLORA OF THE NORTHEASTERN ATLANTIC OFF PORTUGAL; I. SIZE AND COMPOSITION OF THE BACTERIAL POPULATION,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
G. Rheinheimer, and R. Schmaljohann.
Botanica Marina, Vol. 26, No. 3, p 137-152, March, 1983. 17 Fig, 3 Tab, 25 Ref.

Descriptors: *Eutrophication, *Bacteria, Upwelling, Marine environment, River flow, River mouth, Saprophytic bacteria.

Investigations conducted in May of 1981 off the western and southern coasts of Portugal indicate that upwelling dominated at this time throughout the area. Bacterial counts and biomass measurements were distinctly higher than in April of 1980. Bacteriological variables revealed differences between the northern and southern sections in accordance with the particular upwelling situations. Terrigenous influence proved to be restricted to the mouths of the rivers Douro and Tejo, and were evidenced through a rise in the numbers of saprophytes at the stations nearest the coast. Total bacterial counts exhibited only small differences compared to stations further offshore. The terrigenous influence was stronger in the the area of the mouth of the Tejo, where at a depth of 100 m, 1085 saprophytes/ml were counted. In general, total bacterial counts decreased with increasing depth, although in some cases an increase of bacterial numbers at depths of 500-1000 m was found. In certain locations the percentage of dividing cells in subsurface water layers was greater than at the surface. The distribution of a few morphologically distinguished groups of bacteria showed differences within the area of study and from other regions of the sea. (Moore-IVI)
W84-01475

SEWAGE POLLUTION AND THE INFAUNAL BENTHOS OF VICTORIA HARBOUR, HONG KONG,
Fisheries Research Station, Aberdeen (Hong Kong).
G. B. Thompson, and P. K. Shin.
Journal of Experimental Marine Biology and Ecology, Vol. 67, No. 3, p 279-299, March, 1983. 9 Fig, 5 Tab, 56 Ref.

Descriptors: *Water pollution effects, *Benthic fauna, *Wastewater pollution, Tidal currents, Harbors, Typhoon shelters, Abiotic areas, Polychaetes, Oligochaetes, Mollusks, Species diversity, Biomass, Biological communities, Hong Kong.

Victoria Harbor, Hong Kong, receives 800 mi
l/day of untreated sewage from 3.6 million pe
but is flushed by tidal currents at velocities u
1.1 m/s. Two replicate Smith-McIntyre grab
ples were collected at 66 stations in August
yielding a total of 5797 animals belonging t
species. Agglomerative hierarchical classifica
was used to delineate five station groups; a
group contained four stations where no fauna
found. All but one of the groups inhabited
sediments (>70% silt-clay) and could be pla
along a gradient conforming to the typical pat
of organic pollution effects found in boreal
temperate waters. Abiotic areas, found in encl
typhoon shelters, were successively replaced b
very poor fauna, a peak of opportunists, an ecot
point and a transition to normal fauna. The peal
opportunists was dominated by the oligochа
Thalassodrilides gurwitschi (Hrabe); the p
chaetes Capitella capitata (Fabricius) and Minu
cirrifera (Wiren) were also numerous. Ove
abundance was low (784 individuals/sq m) c
pared with opportunists in boreal and temper
waters. The remaining station group was found
coarser sediments (<40% silt-clay) and an infl
tion was observed in the log-normal distributio
individuals per species. Dominant species inclu
the bivalve Tapes philippinarum (Adams
Reeve) and the polychaete M. cirrifera; ove
abundance was high (1103 individuals/sq m).
general, pollution was assessed by the pattern
changes in number of species, abundance, biom
diversity and evenness, by log-normal distributi
of individuals per species, and by the indica
species M. cirrifera. When compared with earl
(1976) data, community conditions were genera
similar but the abundance of individual spec
varied greatly and M. cirrifera was absent. T
severely polluted area was about 15 sq km; this
similar in extent to offshore discharge sites a
indicates the importance of tidal flushing in t
inshore channel. (Author's abstract)
W84-01477

**BIOCONCENTRATION OF CHLOROBE
ZENES FROM WATER BY RAINBOW TROU
CORRELATIONS WITH PARTITION COEFF
CIENTS AND ENVIRONMENTAL RESIDUE**
B. G. Oliver, and A. J. Niimi.
Environmental Science Technology, Vol. 17, N
5, p 287-291, May, 1983. 1 Fig, 3 Tab, 25 Re

Descriptors: *Biological magnification, *Chlorina
ed hydrocarbons, *Benzenes, *Trout, Hexachlor
butadiene, Hexachloroethane, Lake Ontario, Part
tion.

The bioconcentration by rainbown trout of te
chlorobenzenes (CB's), hexachlorobutadien
(HCBD), and hexachloroethane (HCE) at wate
concentrations near environmental levels (nan
grams per liter range) has been studied. The bio
concentration factor (BCF) for the CB's was foun
to increase dramatically as the degree of chlorin
substitution on the aromatic ring became greate
There was a high correlation between the BC
and the octanol water partition coefficient fo
HCBD, HCE, and all the chlorobenzenes excep
hexachlorobenzene (HCB). Ten adult rainbow
trout from Lake Ontario were analyzed for thes
contaminants. Then, with use of field values fo
contaminant concentrations in water and labora
tory values for BCF's, predictions of field concen
trations in fish (on the basis of accumulation fro
water only) were made. These values were the
compared to the fish field data. (Author's abstract
W84-01501

**GILL SURFACE INTERACTION MODEL FOR
TRACE-METAL TOXICITY TO FISHES: ROLE
OF COMPLEXATION, PH, AND WATER
HARDNESS,**
Montana State Univ., Bozeman. Dept. of Chemis
try.
G. K. Pagenkopf.
Environmental Science and Technology, Vol. 17,
No. 6, p 342-347, June, 1983. 6 Tab, 40 Ref.

Descriptors: *Toxicity, *Trace metals, *Fish,
Alkalinity, Hardness, Hydrogen ion concentration,

r, Cadmium, Lead, Zinc, Mathematical

el has been developed to account for the ity in trace-metal toxicity to fishes at differ- ues of alkalinity, hardness, and pH. The utilizes trace-metal speciation, gill surface ion, and competitive inhibition to predict e toxicant concentration (ETC). Copper, m, lead, and zinc bioassay data have been . (Author's abstract)
503

NAL VARIATION OF CADMIUM TOX- TOWARD THE ALGA SELENASTRUM CORNUTUM PRINTZ IN TWO LAKES DIFFERENT HUMUS CONTENT,
niv. (Norway). Inst. for Kjemi.
greid, J. Alstad, D. Klaveness, and H. M.

nmental Science and Technology, Vol. 17, 357-361, June, 1983. 5 Fig, 1 Tab, 29 Ref.

tors: *Cadmium, *Toxicity, *Organic Selenastrum, Chlorophyta, Eutrophication, l variation, Ions, Decomposing organic Dissolved solids.

a Selenastrum capricornutum Printz is used tigate the potential of natural lake water to cadmium toxicity. The two lakes involved trophic status and in concentration and ition of dissolved organic matter, one being l dystrophic bog lake, the other a less influenced, eutrophic lake. In the dystro- e, the toxic effect is determined mainly by cadmium activity. In the eutrophic, less nfluenced lake, however, the toxic effect onsiderable seasonal variations with a tox- exceeding what would be expected ac- to the estimated free ion activity during It is hypothesized that qualitative changes mposition of the dissolved organic matter he production period are responsible for ct. (Author's abstract)
504

EPOSITION AND FOREST DECLINE,
hnson, and T. G. Siccama.
mental Science and Technology, Vol. 17, 294-305, July, 1983. 13 Fig, 1 Tab, 55 Ref. 08-1982, APP-0099-1981.

ors: *Acid rain, *Water pollution effects, Forest management, Vegetation, Spruce, Trace metals.

uce in the high elevation forests of New ermont, and New Hampshire has shown dieback and a very large reduction in basal density over the past 15-20 years. Similar s were noted in West Germany. In both s the affected forests are located in areas eive large atmospheric inputs of acidic es and other pollutants. The location, to- y and other characteristics of these forests em to be receptors of high levels of acid n and airborne trace metals. Several possi- ways exist by which acid deposition could te to spruce mortality. Evidence regarding ing effect of droughts is being substantiat- wever, whether drought is sufficient to e dieback or whether there is additional m pollution is not clear. The possibility of stresses is considered. Drought following ction by secondary organisms appears cid deposits could enhance drought stress ersa. (Baker-IVI)
06

OF ORGANIC POLLUTION IN L LAGOONS OF TABASCO STATE, ; I: PETROLEUM HYDROCARBONS,
tello, J. A. Goni, and S. A. Castro.
of Environmental Contamination and gy, Vol. 31, No. 3, p 217-277, September, ig, 2 Tab, 10 Ref.

ors: *Hydrocarbons, *Oil pollution, *La- oastal areas, Sediments, Oysters, Bioaccumulation, Oil spills, Storms, Oil industry, Tabasco, Mexico.

More than 100 samples of sediments and oysters (Crassostrea virginica) were collected at 27 stations located in the Carmen-Machona and Mecoacan lagoons in Tabasco, Mexico, during four periods: October, 1979; January, March, and May, 1980. The majority of values obtained for total hydrocarbon concentrations in sediments are below 70 ppm; they correspond to hydrocarbon concentrations in coastal areas considered to be non-polluted. The highest concentrations (1060 and 305 ppm) reflect the influence of oil spilled in the Ixtoc-I accident, which was carried to the coast by tropical storm 'Henry' in September, 1979. The remaining values between 80 and 150 ppm (18%) are probably due to fluvial discharges and runoff from adjacent areas where exploration, exploitation and crude oil refinement are carried out. The results obtained in May are all less than 70 ppm, which could indicate that fossil hydrocarbons do not remain in the sediments of the lagoon studied because of the great dynamism of the coastal ecosystems. The results obtained for oysters coincide with those reported for bivalves from lagoons, bays and canals affected by oil industry activities and accidents. The greatest concentrations of hydrocarbons in oysters were observed principally in October, which may indicate that these organisms had bioaccumulated compounds or adsorbed particles of oil from the Ixtoc-I accident. In general, the values obtained for oysters indicate chronic pollution. (Moore-IVI)
W84-01585

ACUTE TOXICITY OF CHLORINE AND BROMINE TO FATHEAD MINNOWS AND BLUEGILLS,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
E. W. Wilde, R. J. Soracco, L. A. Mayack, R. L. Shealy, and T. L. Broadwell.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 3, p 309-314, September, 1983. 2 Tab, 19 Ref. DE-AC09-76SR00001.

Descriptors: *Chlorination, *Biocides, *Toxicity, *Bromine, Fish, Cooling water, Antifouling agents, Residual chlorine, Residual bromine, Fathead minnows, Bluegills.

Several alternatives to chlorination have recently been proposed including the use of a bromine-based biocide, 1-bromo-3-chloro-5,5-dimethylhydantoin (BCDMH). The relative toxicity of chlorine and BCDMH to three types of fish were compared in a freshwater system used for cooling a nuclear reactor. Flow-through 96-hr toxicity tests were conducted using water from Par Pond, a reactor cooling reservoir at the Savannah River Plant near Aiken, S.C. Juvenile and yearling fathead minnows and young-of-the-year bluegills were used as test organisms. Median lethal concentrations for total residual chlorine (TRC) and total residual bromine (TRB) were statistically compared. Juvenile fathead minnows were significantly more tolerant of TRB than TRC. TRC and TRB 96-hr median lethal concentrations for adult fathead minnows were not significantly different. Bluegills were significantly more tolerant of TRC than TRB. Bluegills were significantly more tolerant of both biocides than were fathead minnows. Adult minnows were significantly more tolerant of both biocides than juvenile minnows. (Moore-IVI)
W84-01586

COMPARATIVE STUDY OF THE EFFECTS OF METALS ON THE SETTLEMENT OF CRASSOSTREA GIGAS,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
H. R. Watling.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 3, p 344-351, September, 1983. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Oysters, *Heavy metals, *Water pollution effects, *Larvae, Growth stages, Zinc, Cadmium, Copper, Lead, Manganese, Nickel, Cobalt, Chromium, Spat, Behavior, Mortality.

The effects of eight elements on Crassostrea gigas larval settlement and spat growth have been investigated using a single larval culture for each comparative test. The metal concentrations were chosen in the range to cause sub-lethal rather than lethal effects. Zinc, cadmium, copper, lead, manganese, nickel, cobalt, and chromium were tested at 10 and 20 micro g/l. Experimental observations included growth and behavior in addition to mortality. Of the eight elements studied, only copper and manganese were not detrimental to C. gigas settlement success. Larval behavior was not noticeable different for the various treatments in this experiment. Zinc and lead delayed settlement, and copper and cobalt induced early settlement. Zinc, cadmium, copper, lead, manganese, nickel, cobalt and chromium in the 10-20 micro g/l range all caused a reduction in spat growth during metal exposure. Low copper concentrations (20-40 micro g/l), added to the water immediately prior to larval settlement and for only two or three days may stimulate larval settlement. (Moore-IVI)
W84-01588

COMPARATIVE BIOACCUMULATION AND ELIMINATION OF HCH ISOMERS IN SHORT-NECKED CLAM (VENERUPIS JAPONICA) AND GUPPY (POECILIA RETICULATA),
Moji Public Health Center (Japan).
Y. Yamato, M. Kiyonaga, and T. Watanabe.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 3, p 352-359, September, 1983. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Bioaccumulation, *Pesticide residues, *Elimination, Insecticides, Guppy, Clam, HCH, Lindane, Chlorinated hydrocarbons.

In Japan, HCH had been one of the most applied insecticides to arable fields, especially to rice paddies. Residues of alpha, beta, and delta HCH have been detected as well as insecticidally active gamma HCH in the environment because technical grade HCH had been formulated and marketed as HCH insecticide. Comparative bioaccumulation and elimination of 4 HCH isomers by short-necked clam (Venerupis japonica) and guppy (Poecilia reticulata) were examined. Alpha, beta, gamma, and delta HCH were dissolved in water at concentrations of 1, 2, 1, and 2 ppb, respectively and the clams or guppies were exposed for 10 days, and then removed to HCH-free flowing water. The guppy rapidly bioaccumulated HCH isomers and the concentrations reached a plateau on the 4th day. The bioaccumulation ratios (BR) of alpha, beta, gamma, and delta HCH were 706, 1043, 697, and 648 times on that day, respectively. Concentrations of HCH isomers in the guppy smoothly decreased on the first day after replacement to HCH-free water, and constantly declined afterwards. Short-necked clams rapidly absorbed HCH isomers, and the concentrations reached a plateau on day three. The BR of alpha, beta, gamma, and delta HCH were 161, 127, 121, and 272 times, respectively. Concentrations of each HCH isomer in clams constantly decreased after replacement to HCH-free water. (Moore-IVI)
W84-01589

CHRONIC TOXICITY TO FATHEAD MINNOW PIMEPHALES PROMELAS OF WASTEWATER FROM A CONVENTIONAL WASTEWATER TREATMENT SYSTEM RECEIVING ORGANIC PRIORITY POLLUTANTS,
Environmental Research Lab.-Duluth, Cincinnati, OH. Newtown Fish Toxicology Station.
Q. H. Pickering.
Environmental Pollution (Series A), Vol. 31, No. 3, p 105-117, June, 1983. 4 Tab, 17 Ref.

Descriptors: *Effluent, *Toxicity, Fathead minnows, Chlorination, Hatching, Growth, Larval growth stages, Wastewater treatment, Organic compounds, Priority pollutants, Mortality.

Chronic toxicity tests were made with unchlorinated and dechlorinated effluent from a conventional wastewater treatment system receiving 22 organic

priority pollutants. The early-life-stage (ELS) tests began with fathead minnow embryos less than 1-day old and exposure continued for 30 days post hatch. There was no significant difference in hatchability between any effluent concentration (5.0-0.16%) and control. Survival and growth of larvae-juveniles in all unchlorinated concentrations were similar to controls. The chronic value for this exposure was > 5% and the acute-chronic ratio was < 6.6. Survival and growth of fish in 5% dechlorinated effluent were significantly less than survival and growth of control fish. Survival of fish in the 2.5% effluent was similar to survival of control fish. However, growth of these fish was only 75% of control fish and was significantly less than growth of control fish. Survival and growth of fish in the 1.3% effluent were not different from controls. The chronic value of the dechlorinated effluent was 1.8% and the acute-chronic ratio, about 19.
W84-01591

A NOTE ON THE EFFECTS OF CRUDE OIL ON MICROBIAL ACTIVITIES IN A STREAM SEDIMENT,
Oregon State Univ., Corvallis. Dept. of Microbiology.
J. H. Baker, and R. Y. Morita.
Environmental Pollution (Series A), Vol. 31, No. 2, p 149-157, June, 1983. 1 Fig, 1 Tab, 15 Ref. NOAA Contract 03-05-022-68.

Descriptors: *Oil pollution, *Stream sediments, *Microorganisms, Metabolism, Nitrogen fixation, Carbon dioxide, Methanogenesis, Phosphatase, Mud, Hydrocarbons.

Rivers are the most important transport systems for hydrocarbon wastes which may arise from both accidental spills and controlled effluents. However, the influence of crude oil on normal metabolic processes occurring in river sediments has been largely neglected. The work described was a pilot study designed to demonstrate the effects of spilled oil on a wide range of microbial activities in a stream mud. The stream chosen was Berry Creek, a controlled minor tributary of the Willamette watershed in western Oregon. Rates of CO2 production, nitrogen fixation and methanogenesis, Vmax for glucose, and phosphatase levels were all determined in the presence and absence of crude oil. Four weeks after the oil addition the Vmax and phosphatase levels were significantly reduced and remained so, but methane and CO2 production rates were both significantly increased. Nitrogen fixation was not affected by 0.1% (v/v) oil, but was reduced after 8 weeks by 1.0% oil.
W84-01592

ACUTE TOXICITY OF A DITHIOCARBAMATE FUNGICIDE, THIRAM, WITH REGARD TO SEVERAL SPECIES OF FRESHWATER ANIMALS (TOXICITE AIGUE D'UN FONGICIDE DITHIOCARBAMATE, LE THIRAME, VIS A VIS DE PLUSIEURS ESPECES ANIMALES D'EAU DOUCE),
Paris-11 Univ., Orsay (France). Lab. de Zoologie.
J. Seuge, D. Marchal-Segault, and R. Bluzat.
Environmental Pollution (Series A), Vol. 31, No. 3, p 177-189, July, 1983. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Toxicity, *Thiram, Fungicides, Mollusks, Amphibians, Crustacea, Insects, Platyhelminths.

Acute toxicity experiments (24, 48, 72 and 96 h) were carried out with an aqueous suspension of thiram (commercial powder titered at 80%). The animal sensitivity was very variable, the 24-h and 96-h LC 50's being 0.53 ppm and 0.048 ppm (Dugesia gonocephala, plathelminth), 1882 ppm and 61 ppm (Asellus aquaticus, crustacean), 0.017 ppm and 0.013 ppm (Xenopus laevis, amphibian, stage 47), 0.025 ppm and 0.021 ppm (Xenopus, stage 53). In all cases, the LC50 related to time can be described by the law $y = axb$, this permitted us to compare the present results with those already obtained in Lymnaea stagnalis (molluscan), Gammarus pulex (crustacean) and larvae of Cloeon dipterum (insect). The slopes of these curves indicate three types of reaction: one in the two crustaceans (Asellus and Gammarus), one in Lymnaea and Dugesia and one in Cloeon and Xenopus larvae. The six species studied can be classified according to increasing sensitivity as follows: Asellus, Lymnaea, Gammarus and Cloeon larvae at the same level, Dugesia and Xenopus larvae; the spectrum of thiram activity is in the range 10 pptm to 5000-6000ppm: it is then very large. It can be concluded that thiram, a fungicide intensively used in agriculture, presents a real threat to all freshwater fauna. (Author's abstract)
W84-01593

TOXICITY, ACCUMULTION AND CLEARANCE OF AROMATIC HYDROCARBONS IN DAPHNIA PULEX,
Ottawa Univ. (Ontario). Dept. of Biology.
R. G. Trucco, F. R. Engelhardt, and B. Stacey.
Environmental Pollution (Series A), Vol. 31, No. 3, p 191-202, July, 1983. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Hydrocarbons, *Toxicity, *Bioaccumulation, Daphnia, Metabolism, Benzene, Naphthalene, Phenanthrene, Benzo(a)anthracene, Benzo(a)pyrene.

Exposure of the zooplankter Daphnia pulex to five aromatic hydrocarbons in water determined an increasing toxicity in the order of benzene, naphthalene, phenanthrene, benzo(a)anthracene to benzo(a)pyrene, as measured by 96-h LC50 values. These ranged exponentially from 15 mg/l for benzene to 5 micro g/l for benzo(a)pyrene. Accumulation after 24 h of exposure was found to be specific to the aromatic hydrocarbon, measured as 14C-aromatic hydrocarbon load, as well as to the vector of exposure. Naphthalene accumulation was greatest, about 11 thousand times from algal food, while benzo(a)anthracene and benzo(a)pyrene accumulated more from the water, about one and three thousand times, respectively. Benzene was least accumulated. Clearance of the accumulated aromatic hydrocarbons occurred rapidly in all cases but naphthalene. Naphthalene clearance by 72 h after cessation of exposure was only 17 to 30% of the 24-h hoad, while the other four hydrocarbons were cleared by an average of 85%. (Author's abstract)
W84-01594

ALKYL LEAD POLLUTION AND BIRD MORTALITIES ON THE MERSEY ESTUARY, UK, 1979-1981,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
K. R. Bull, W. J. Every, P. Freestone, J. R. Hall, and D. Osborn.
Environmental Pollution (Series A), Vol. 31, No. 3, p 239-259, August, 1983. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Birds, *Mortality, *Trialkyl lead, Organolead compounds, Waterfowl, Toxicity, Invertebrates, Industrial wastes, Chemical industry, Estuaries, Mersey Estuary, England.

In autumn 1979 about 2400 birds of many species were found dead and sick on the Mersey Estuary, UK, which is an important wader and wildfowl wintering area. Smaller mortalities occurred in 1980 and 1981. Affected birds contained elevated lead levels, much of the lead being in the form of alkyl lead. Apparently healthy birds contained lower amounts of alkyl lead but still enough to cause some ill-effects. Trialkyl lead compounds (on the order of 80 kg/day) were discharged into the Mersey-Manchester Ship Canal system from petrochemical works at levels which would account for the levels found in invertebrates on which the birds could feed. Such concentrations in invertebrates could easily lead to birds accumulating the levels of trialkyl lead found in their tissues. Several thousand apparently healthy birds were apparently also at risk. (Moore-IVI)
W84-01595

MALATHION INDUCED HEMATOLOGICAL AND BIOCHEMICAL CHANGES IN THE INDIAN CATFISH HETEROPNEUSTES FOSSILIS,
Gorakhpur Univ. (India). Dept. of Zoology.
J. Mishra, and A. K. Srivastava.
Environmental Research, Vol. 30, No. 2, p 398, April, 1983. 3 Tab, 33 Ref

Descriptors: *Toxicity, *Malathion, *Catfish, ticides, Metabolism, Chloride, Blood, Patho

The acute toxicity and effects of duration of thal exposure to malathion were determined Indian catfish (Heteropneusters fossilis). Fis posed to the pesticide for 2, 6, 12, 48, and showed muscle glycogenolysis with concom hyperglycemia at all intervals; hepatic glyc was unaffected. Malathion was also associated hypochloremia at 2 and 6 hr and hyperchlor at 48 and 96 hr; blood chloride concentration unaffected at 12 hr. Fish developed erythro and leukopenia; lowered hematocrit and hem bin content and hypercoagulability of blood also observed. The data showed that homeos and hemostatic mechanisms are disturbed malathion treatment and could be helpful for uating pesticide toxicosis in fish. (Author's stract)
W84-01601

ANALYSIS OF THE EFFECT OF INDUSTR EFFLUENT ON PIGMENTS, PROTEINS, CLEIC ACIDS, AND THE 2,6-DICHLO PHENOL INDOPHENOL HILL REACTION RICE SEEDLINGS,
Indian Inst. of Tech., New Delhi. Centre for medical Engineering.
B. K. Behera, and B. N. Misra.
Environmental Research, Vol. 31, No. 2, p 389, August, 1983. 7 Fig, 16 Ref.

Descriptors: *Industrial wastewater, *Plant pat ogy, Effluent, Rice, Seedlings, Nucleic a Chlorophyll, Pigments, Food-processing waste

The effect of an effluent from a distillery of a s factory on cellular macromolecular composi and indophenol photochemical activity of isol chloroplasts of rice (Orvza sativa c.v. Musho seedlings was investigated. The effluent, whic known as spend wash, contains high concen tions of various cations and anions. The total ments, proteins, and nucleic acids of rice seedl declined with an increase in effluent concentra and the time of incubation. The loss in content macromolecules like deoxyribonucleic (DNA), ribonucleic acid (RNA), and protein relatively more marked in the root than in shoot. RNA and chlorophyll (Chl) contents of seedlings were found most susceptible to effl stress. Loss in Hill reaction activity measure photoreduction of 2,6-dichlorophenol indoph (DCPIP) of isolated chloroplasts could be corre ed in a general way with the loss of pigme proteins and nucleic acids. Diphenyl carbaz induced and Mn(2+)-induced restoration of los DCPIP photoreduction suggests that the dam of oxygen evolving systems is the initial site action of the effluent. (Moore-IVI)
W84-01602

PESTICIDE-INDUCED DYSFUNCTION CARBOHYDRATE METABOLISM IN THR FRESHWATER FISHES,
D.A.V. Coll., Muzaffarnagar (India). Pollu Relevant Research Lab.
S. R. Verma, S. Rani, I. P. Tonk, and R. C. Dal
Environmental Research, Vol. 32, No. 1, p 133, October, 1983. 3 Tab, 31 Ref.

Descriptors: *Toxicity, *Metabolism, *Pesticid *Fish, Thiotox, Dichlorvos, Organophospho pesticides, Chlorinated hydrocarbon pesticid Blood, Liver, Muscle.

The effect of sublethal fractions (1/4th, 1/8th 1/16th of 96-hr LC50) of thiotox and dichlor on blood glucose, lactate, and liver and mus glycogen levels of Clarias batrachus, Saccobr chus fossilis, and Mystus vittatus, exposed for days, have been studied. Blood glucose and lact levels increased from 29.13 to 98.36% and fr 10.88 to 36.36%, respectively. The liver muscle glycogen decreased from 22.99 to 69.3 and from 5.19 to 32.19%, respectively. This car

nbalance may be a result of weaker corti-
ice and gluconeogenesis, enhanced gly-
eakdown, increased adrenocorticotropic
secretion, or an imbalance in insulin re-
om structural damage to the pancreas.
VI)
3

OGIC EVALUATION OF A POPULA-
POSED TO ARSENIC IN ALASKAN
ATER,
r Disease Control, Atlanta, GA. Center
nmental Health.
M. M. Zack, R. G. Feldman, C. A.
J. Chirico-Post.
of Environmental Health, Vol. 38, No. 2,
March-April, 1983. 4 Tab, 23 Ref.

s: *Arsenic, *Toxicity, *Drinking water,
pathology, Well water, Neuropathy,
tals, Ester Dome, Alaska.

s of arsenic in well water and in biologic
ave previously been found for residents
ome, Alaska, a residential area just out-
irbanks. One hundred forty-seven per-
sed to arsenic from well water were
by neurologic examination and nerve
n studies. Total arsenic concentrations in
ranged from 1 to 4781 micro g/L and
4964 micro g/L in urine; a calculated
rsenic ingestion ranged from 1 to 4521
ay. No dose-response relationship existed
rsenic ingestion and symptoms or physi-
gs compatible with peripheral neurop-
of six persons with symptoms or physi-
s suggestive of sensory neuropathy had
rve conduction velocities. Thirteen per-
elevated arsenic ingestion but no signs or
or neuropathy had one or more abnor-
conduction velocities. No dose-response
p, however, existed between arsenic in-
d nerve conduction velocities. Arsenic
rom well water at the concentrations
his Alaskan community apparently did
in clinical or subclinical neuropathy.
I)

ATIVE ACUTE TOXICITIES OF SUR-
S TO AQUATIC INVERTEBRATES,
d Gamble Co., Cincinnati, OH.
is, and D. Suprenant.
ogy and Environmental Safety, Vol. 7,
3-322, June, 1983. 1 Fig, 4 Tab, 29 Ref.

s: *Toxicity, *Surfactants, *Inverte-
aphnia, Dero, Asellus, Dugesia, Rhabdi-
arus.

ons of the toxicity of surfactants to
vertebrates have been limited primarily
ning the effects on a few species. The 48-
alues for three surfactants are reported
cies of aquatic invertebrates. The acute
or each surfactant (mg/l) varied 159 to
were as follows: C11.8LAS (anionic), 1.7
to 270 (Asellus sp.); C14-15 alkylethoxy-
nic), 1.0 (Dugesia sp.) to 6.8 (Rhabditis
C (cationic), 0.1 (Gammarus sp.) to 587
.). When compared to previously devel-
Daphnia magna was typically found to
t sensitive of all species tested, including
e surfactants. The use of D. magna in
oxicity tests will provide a conservative
f surfactant toxicity for aquatic inverte-
also for bluegill and fathead minnows.
I)
3

IN: FILTERING OUT THE FACTS,
al Engineering, Vol. 64, No. 5, p 7-9,
2 Fig.

s: *Acid rain, *Reviews, United States,
anada, Water pollution sources, Acidity,
g, Environmental effects.

em confronting the researcher examining
m of acid rain is the lack of essential records much before the mid-sixties. Descriptions of 19th and early 20th century industrial operations both in the United States and Europe suggest a higher level of polluted air and water than would be tolerated now. A pH of 5.6 is considered normal. Rain and snow in particularly vulnerable areas may consistently measure less than 4.5 pH. The disposition of atmospheric contaminants occurs from two related atmospheric processes often identified as rainout and washout. A plan has been proposed where Canada and the US will have a permanent acid deposition measurement system with specific monitors strategically placed. With the usual systems for monitoring rain, only cations and anions can be measured, but not trace elements. The application of limestone to acidified lakes and streams requires considerable knowledge both of input sources to the lake and of water turnover times. Liming tends to increase aluminum and cadmium accumulations in waters with 4-6 pH levels, thus intensifying the likelihood of fish kills. While electric utilities often are cited as the major contributor to the problem, seldom does one hear of that industries contributions toward research funding to solve the problem. Without accurate long-term monitoring data, researcher have had to calculate acidity trends in presumably vulnerable areas. At times they may have had to assume that forest, crop and fish kills came from acid rain as they had no way to assess other factors such as whether some soils and waters in specific areas have ever consistently supported certain crops and certain types of aquatic life. (Baker-IVI)
W84-01610

STUDIES OF A SPRING PHYTOPLANKTON BLOOM IN AN ENCLOSED EXPERIMENTAL ECOSYSTEM. I. BIOCHEMICAL CHANGES IN RELATION TO THE NUTRIENT CHEMISTRY OF WATER,
Institute of Oceanographic Sciences, Wormley (England).
R. J. Morris, M. J. McCartney, and G. A. Robinson.
Journal of Experimental Marine Biology and Ecology, Vol. 70, No. 3, p 249-262, August, 1983. 7 Fig, 2 Tab, 57 Ref.

Descriptors: *Diatoms, *Eutrophication, *Nutrients, Lochs, Biochemistry, Species composition, Decomposition, Metabolism, Coastal waters, Loch Ewe, Scotland.

A spring bloom of diatoms which occurred in large enclosed ecosystem bags at Loch Ewe, Scotland, during 1980, has been the subject of a chemical study. Changes observed in the general biochemical composition of the diatoms during the bloom are compared with the species distribution and changes in the nutrient chemistry of the bag water. The results indicate that major changes in cell biochemistry are associated with the growth, development, and decay of a diatom bloom, particularly if one or more nutrients become limiting. Of particular note is the growth of carbohydrate levels in the cells when lipid and protein levels fall and the apparent shift in lipid metabolism from mainly non-polar lipids at the onset of growth to more polar lipids as the bloom proceeds, then back to less polar lipids as phosphate becomes limiting. (Moore-IVI)
W84-01642

MICROBIOLOGICAL SURVEY OF ADIRONDACK LAKES WITH VARIOUS PH VALUES,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
C. W. Boylen, M. O. Shick, D. A. Roberts, and R. Singer.
Applied and Environmental Microbiology, Vol. 45 No. 5, p 1538-1544, May, 1983. 5 Fig, 3 Tab, 35 Ref.

Descriptors: *Microorganisms, *Hydrogen ion concentration, *Oligotrophic lakes, *Bacteria, Adaptation, Heterotrophic bacteria, Acid rain, Adirondack lakes, New York.

Atmospheric acidic deposition has not been well described in terms of its effects on aquatic microbial populations. Many of the lakes in the Adirondack region of New York State are particularly sensitive to high H(+) inputs from acidic deposition. It is important that these ecosystems be examined so that future changes can be appraised. Nine high-altitude oligotrophic Adirondack lakes having water of pH 4.3 to 7.0 were surveyed for total bacterial numbers and possible adaptation of the microbial communities to enviromental pH. The number of heterotrophic bacteria from water samples recoverable on standard plate count agar were low (10 to 1000 per ml) for most of the lakes. Acridine orange direct counts were approximately two orders of magnitude higher than plate counts for each lake. Sediment aerobic heterotrophs recovered on standard plate count agar ranged from 14000 to 1,300,000 per g of sediment. Direct epifluorescence counts of bacteria in sediment samples ranged from 3,000,000 to 1.4 x 10 to the 7th power per g. Low density values were consistent with the oligotrophic nature of all the lakes surveyed. There were no apparent differences in numbers of bacteria originally isolated at pH 5.0 and pH 7.0 between circumneutral lakes (pH $>$ 6.0) and acidic lakes (pH $<$ 5.0). Approximately 1,200 isolates were recultured over a range of pH from 3.0 to 7.0. Regardless of the original isolation pH (pH 5.0 or pH 7.0), less than 10% of the isolates grew at pH $<$ 5.0. Those originally isolated at pH 5.0 also grew at pH 6.0 and 7.0. Those originally isolated at pH 7.0 preferred pH 7.0, with 98% able to grow at pH 6.0 and 44% able to grow at pH 5.0. A chi-square contingency test clearly showed ($P < 0.005$) that two distinct heterotrophic populations had been originally isolated at pH 5.0 and pH 7.0, although there is undoubtedly some overlap between the two populations. (Moore-IVI)
W84-01654

EFFECTS OF METALS ON METHANOGENESIS, SULFATE REDUCTION, CARBON DIOXIDE EVOLUTION, AND MICROBIAL BIOMASS IN ANOXIC SALT MARSH SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. G. Capone, D. D. Reese, and R. P. Kiene.
Applied and Environmental Microbiology, Vol. 45, No. 5, p 1586-1591, May, 1983. 1 Fig, 2 Tab, 25 Ref. NOAA grant NA-80-RAD-00057, EPA grant R-809475-01-0, NSF grant OCE-82-00157.

Descriptors: *Salt marshes, *Sediments, *Microorganisms, *Heavy metals, *Anaerobic conditions, *Metabolism, Methane production, Carbon dioxide, Sulfates, Water pollution effects.

The effects of several metals on microbial methane, carbon dioxide, and sulfide production and microbial ATP were examined in sediments from Spartina alterniflora communities. Anaerobically homogenized sediments were amended with 1,000 ppm (ratio of weight of metal to dry weight of sediment) of various metals. Time courses in controls were similar for CH4, H2S, and CO2, with short initial lags (0 to 4 h) followed by periods of constant gas production (1 to 2 days) and declining rates thereafter. Comparisons were made between control and experimental assays with respect to initials rates of production (after lag) and overall production. Methane evolution was inhibited both initially and overall by CH3HgCl, HgS, and NaAsO2. A period of initial inhibition was followed by a period of overall stimulation with Hg, Pb, Ni, Cd, and Cu, all as chlorides, and with ZnSO4, K2CrO4, and K2Cr2O7. Production of CO2 was generally less affected by the addition of metals. Inhibition was noted with NaAsO2, CH3HgCl, and Na2MoO4. Minor stimulation of CO2 production occurred over the long term with chlorides of Hg, Pb, and Fe. Sulfate reduction was inhibited in the short term by all metals tested and over the long term by all but FeCl2 and NiCl2. Microbial biomass was decreased by FeCl2, K2Cr2O7, ZnSO4, CdCl2, and CuCl2 but remained generally unaffected by PbCl2, HgCl2, and NiCl2. Although the majority of metals produced an immediate inhibition of methanogenesis, for several metals this was only a transient phenomenon followed by an overall stimulation. The initial suppression of methanogenesis may be relieved by precipitation, complexation, or transformation of

the metal (possibly by methylation), with the subsequent stimulation resulting from a sustained inhibition of competing organisms (e.g., sulfate-reducing bacteria). For several environmentally significant metals, severe metal pollution may substantially alter the flow of carbon in sediments. (Author's abstract)
W84-01656

REPORT ON EUTROPHICATION STUDIES IN THE U.S.S.R.,
Moscow State Univ. (USSR). Dept. of General Ecology and Hydrobiology.
A. M. Ghilarov.
Water Resources, Vol. 17, No. 6, p 607-611, June, 1983. 39 Ref.

Descriptors: *Eutrophication, *USSR, *Nutrients, Pollution load, Municipal wastewater, Nonpoint pollution sources, Cyanophyta, Reservoirs, Mathematical models, Prediction, Phytoplankton, Biomass recovery.

Some results of eutrophication studies in the USSR are briefly reviewed. There are many lakes and man-made reservoirs in the USSR that show symptoms of eutrophication caused mainly by increasing nutrient loading from agricultural land and from municipal wastes. Especially strong eutrophication and heavy blooms of Cyanophyta occur in Dnieper-impounding reservoirs. Eutrophication has not yet touched such large Asian lakes as Issyk-Kul and Baikal, the water quality of which is controlled by special governmental decisions. The enormous number of different freshwater bodies located in various natural zones and in the regions with different human influence makes the forecasting of eutrophication important. Mathematical modeling of eutrophication is being developed in the USSR, along with other methods for the prediction of eutrophication. Although eutrophication most frequently results in a vast development of phytoplankton, in some waters where macrophytes are abundant, eutrophication may not result in blooms for a long time. Prevention of eutrophication can be accomplished by reduction of nutrient input in industrial and municipal wastes. Preliminary work has been done on the recovery of biomass from eutrophic waters and its utilization for fertilizer or as a raw material. (Moore-IVI)
W84-01676

ACID PRECIPITATION: WHAT IS IT DOING TO OUR FORESTS,
Environmental Law Inst., Washington, DC.
G. S. Wetstone, and S. A. Foster.
Environment, Vol. 25, No. 4, p 10-12 and 38-40, May, 1983. 2 Fig, 35 Ref.

Descriptors: *Acid rain, *Forests, Rainfall, Air pollution, Sulfur dioxide, Sulfates, Acidity, Soil properties, Soil chemistry.

Evidence is growing of serious problems in forests of the Central European region and eastern North America. In West Germany, fully 560,000 hectares of forests have recently been damaged. Trees have died in 60,000 ha of the nation's forests, and those in another 100,000 ha are reported to be seriously damaged. In Eastern Europe sulfur dioxide emission levels are extremely high. More than 500,000 ha of forests in Czechoslovakia have been severely damaged. Only recently has acid deposition emerged as a potentially sweeping threat to forests, especially in Central Europe. Some of the devastation is brought about as a consequence of contact between acid waters and the plant tissues. Rainfall in the pH range of 3.0 to 4.0 has been shown to cause tissue injury which can ultimately reduce forest growth. However, rainfall at such a low pH level is not common. Preliminary evidence suggests that indirect effects resulting from acid-induced soil changes are far more important. Acid deposition upsets the natural balance in the soils. Negatively charged sulfate ions, after accumulating in soils, can be washed out by rains, carrying with them nutrients such as calcium and magnesium. Acid conditions also slow the bacterial decompositon needed for the continued production of nutrients. In the long term pollution induced nutrient depletion accelerates the natural forest aging process, leading to the eventual exhaustion of the soil's ability to sustain tree growth. Acid-induced forest impacts are probably magnified in some instances by the increases in rainwater acidity as it passes through the forest canopy and runs down the tree bark, adsorbing in the journey dry-deposited acids present on the surfaces of plants. It is not certain at present whether acid-afflicted forests can be saved or whether acid induced impacts on forests or forest soils reversed. (Baker-IVI)
W84-01700

5D. Waste Treatment Processes

NEW WASTEWATER PROCESS CUTS PLANT COSTS 60%,
Burns and McDonnell, Kansas City, MO.
S. Christopher, and R. Titus.
Civil Engineering, Vol. 53, No. 5, p 39-41, May, 1983. 3 Fig.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, System design, Clarifiers, Sludge digestion, Costs, Municipal wastewater.

A new concept in biological treatment for municipal wastewater combines the aerator and the clarifier into one basin and can thereby slash capital costs up to 60% and operation and maintenance costs up to 45%. Raw sewage enters the treatment system at the aeration basin, is aerated, then passes beneath an innovative intrachannel clarifier. A portion of the mixture of wastewater and activated sludge, commonly called mixed liquor, rises into the clarifier through openings in the clarifier bottom panels. Solids are separated, fall down through the openings and return to the continuously flowing mixture below. Effluent is removed in the upper portion of the clarifier through orifice pipes submerged about one foot beneath the water's surface. As there are no sludge blankets, the full depth of the clarifier is available for maximum settling. Solids settling downward from the quiescent zone also act as a filter to remove materials in the liquor that are flowing up into the quiescent zone. Under varying operating conditions sustained overflow rates ranged from 600 to 2,100 gallons per day per square foot and the BODs and suspended solids effluent requirements were still met. Effluent quality is not significantly degraded when running at very high flow rates due in part to the capability of the clarifer to distribute flow evenly across the entire surface area and to the capability of the submerged orifice effluent system to dampen peak flows. (Baker-IVI)
W84-01481

CHEMICAL CHANGES IN CONCENTRATED, ACIDIC, METAL-BEARING WASTEWATERS WHEN TREATED WITH LIME,
Montana State Univ., Bozeman. Dept. of Chemistry.
D. R. Jenke, G. K. Pagenkopf, and F. E. Diebold.
Environmental Science and Technology, Vol. 17, No. 4, p 217-223, April, 1983. 4 Fig, 5 Tab, 38 Ref. 0264022.

Descriptors: *Lime, *Neutralization, *Acid mine drainage, *Industrial wastewaters, Precipitation, Computers, Simulation, Adsorption, Wastewater treatment, Iron, Magnesium, Manganese, Zinc, Metals.

Appropriate disposal of acid-bearing waters resulting from base-metal industrial works and coal mine drainage continues to be a major problem. Because of economic considerations, lime neutralization with subsequent precipitation is one of the most popular techniques for treatment of these wastewaters. Lime neutralization of acidic wastewaters can prove to be an effective treatment process provided sufficient lime is added. The chemical changes that occur in the system are extensive and varied. Precipitation is predominant with complexation, oxidation, and adsorption playing major roles. Total chemical analyses have identified the chemical changes, and controlled laboratory simulations have identified the relative importance of the physical-chemical processes. The transfer of O2 and CO2 from the atmosphere does not play a major role in the chemistry of t
ring the metals from solution to the solid
The time interval is too short and the ga
interface area is too small to permit sufficie
tities of these two reagents to enter the
Adsorption-coprecipitation is indicated
process that greatly facilitates the rem
Fe(2+), Mg(2+), Mn(2+), and possibly
from solution. Optimum lime addition ra
predicted by thermodynamic computer sim
(Moore-IVI)
W84-01496

WASTEWATER TREATMENT PLANT, ESS CONTROL EXPERIENCES USING ICOMPUTER,
Environmental Protection Service, Bur
(Ontario). Waste Water Technology Centre
B. A. Monaghan.
Canadian Journal of Civil Engineering, V
No. 2, p 214-222, June, 1983. 9 Fig, 1 Tab,

Descriptors: *Activated sludge process, *C
ers, *Wastewater treatment, *Data acq
Automation, Process control, Monitoring
plants.

Since 1978, the Wastewater Technology
has investigated the use of continuous mo
sensors and real-time computers for aut
data acquisition and control of the activated
process. The aim of this work is to improv
performance and reliability through the appl
of effective process control strategies. This
highlights experiences pertaining to: (a) eva
of online instrumentation: (b) software de
ment for data acquisition and control; a
process control strategies investigated. The
ity of this study was carried out using two
16.4 cu m/d pilot plants interfaced to an
minicomputer.
W84-01512

PARTICLE SIZE REDUCTION BY BREA IN BIOLOGICAL WASTEWATER T MENT,
Kansas State Univ., Manhattan. Dept. of Ch
Engineering.
L. A. Glasgow, R. J. Pollock, and W. A. Ba
Biotechnology and Bioengineering, Vol. 25,
p 901-918, April, 1983. 9 Fig, 3 Tab, 2

Descriptors: *Biological wastewater trea
*Floc breakup, *Hydrodynamics, Eddies,
ces, Flocculation, Particle size, Aeration, R
lation, Mixing, Jets.

Floc breakup in biological wastewater tre
occurs in response to hydrodynamic stress
posed by aeration, recirculation, and mixing
size reduction is of particular concern bec
leads to solids carry-over and adversely
process controllability. A laboratory study
size reduction has shown how the hydrody
environment causes breakup and the ext
which it proceeds at particular levels of d
tion. Vortex structures and hairpin eddi
among the most dangerous fluid motions fr
standpoint of floc integrity. The combinat
deformation and rotation can lead to tho
breakage, which appears to be initiated by
ping of subunits from the floc surface; the
daughter particles or fragments, however,
larger than typical primary colloidal particle
structure of jet flows was found to be well
for the reduction of floc size. (Moore-IVI)
W84-01514

SOME FLUIDIZATION CHARACTERIS OF BIOLOGICAL BEDS,
Toronto Univ. (Ontario). Dept. of Civil Eng
ing.
S. W. Hermanowicz, and J. J. Ganczarczyk.
Biotechnology and Bioengineering, Vol. 25,
p 1321-1330, May, 1983. 2 Fig, 2 Tab, 14

Descriptors: *Fluidized beds, *Wastewater
ment, Particles, Drag, Biofilms, Porosity,
Richardson method.

ical fluidized bed technology has been ap- o different processes of wastewater purifica- these applications, the hydraulic character- f the bed may sometimes decide the success re of a particular installation. The free-fall l velocity of particles coated with a nitrify- film was investigated. The drag force exert- he liquid on a biocoated particle was found than that for an uncoated particle. A new a for the drag coefficient was proposed. The nsity of biofilm was estimated as 1.14 g/cu proposed modification of the Zaki-Richard- thod was successfully used for calculations porosity of a fluidized bed. (Moore-IVI) 1515

NDENCE OF BIOLOGICAL TREAT- RATE ON SPECIES COMPOSITION IN ATED SLUDGE OR BIOFILM. I: A BIO- AL TREATMENT MODEL WITH ECO- M ADAPTATION,
niya Nauk SSSR, Moscow. Inst. Vodnykh n.
/avilin, and V. B. Vasiliev.
nology and Bioengineering, Vol. 25, No. 6, -1538, June, 1983. 2 Fig, 6 Tab, 7 Ref.

tors: *Biological wastewater treatment, s composition, Mathematical models, Eco- adaptation, Microorganisms, Organic load-

gical treatment model with ecosystem ad- (ESA model) is proposed as a means of ng multicomponent sewage treatment. The tion of microorganisms which oxidize dif- components of the pollutant is strongly de- on organic loading. The model can be compute multistep treatment systems with microflora at each step. (Author's abstract) 516

NDENCE OF BIOLOGICAL TREAT- RATE ON SPECIES COMPOSITION IN ATED SLUDGE OR BIOFILM. II: FROM LS TO THEORY,
niya Nauk SSSR, Moscow. Inst. Vodnykh n.
/avilin.
nology and Bioengineering, Vol. 25, No. 6, 1570, June, 1983. 18 Fig, 1 Tab, 54 Ref.

tors: *Biological wastewater treatment, matical models, Microorganisms, Pollut- osystem adaptation.

nal biological treatment models are de- rom formal chemical kinetics or dynamics microorganisms cultures growth. The pen- their simplicity is an essentially limited ss. Transition to models which take into the heterogenous nature of the biomass lutant allows one to solve more intricate s and contributes to a better understanding biological treatment process. The best give reasonable approximations of the bio- treatment model with an ecosystem adapta- SA model). The model presented here ex- ome features of the biological treatment ism that cannot be described by formal (Moore-IVI) 517

OVIRUS REMOVAL BY A FULL- TERTIARY TREATMENT PLANT,
mery (James M.), Inc., Pasadena, CA.
Leong, D. G. Argo, and R. R. Trussell.
of the American Water Works Associ- ol. 75, No. 4, p 199-204, April, 1983. 4 Fig, 9 Ref.

tors: *Enteroviruses, *Advanced ater treatment, Disinfection, Chlorination, , Dilution, Injection.

-year study in which enteroviruses were ed at a 56-ML/d (15-mgd) advanced ater treatment plant is summarized. The train included high pH-lime treatment, air g, recarbonation, prechlorination, multime- dia filtration, granular activated carbon adsorption, reverse osmosis demineralization, and final chlorination. The influent and effluent were sampled on the average of once per week. During this study, viruses were detected twice in chlorinated effluent at very low levels and were associated with operational problems of the final disinfection process. Subsequent dilution by blending and injection of the final effluent into a groundwater aquifer, which resulted in additional dilution and treatment, has produced a water that is essentially free of enteroviruses. (Author's abstract)
W84-01525

OVERVIEW OF RURAL WATER AND SANITATION PROGRAMS FOR LATIN AMERICA,
Agency for International Development, Washington, DC. Water and Sanitation for Health Project.
For primary bibliographic entry see Field 5F.
W84-01528

FERRIC CHLORIDE AND ALUM AS SINGLE AND DUAL COAGULANTS,
Air Force Hospital, Wurtsmith AFB, MI.
For primary bibliographic entry see Field 5F.
W84-01529

ODOUR CONTROL IN SOLID WASTE MANAGEMENT,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
J. M. Baker, C. J. Peters, R. Perry, and C. P. V. Knight.
Effluent and Water Treatment Journal, Vol. 23, No. 4, p 133-138, April, 1983. 2 Fig, 2 Tab, 36 Ref.

Descriptors: *Odor control, *Solid wastes, Wastewater treatment, Sulfur, Nitrogen, Oxidation, Cost analysis, Anaerobic conditions, Hydrocarbons, Fatty acids.

The decision to implement odor abatement measures in the management of solid wastes disposal will generally arise as a result of odor nuisance complaints. Odor emissions arise from the disturbance of organic material undergoing anaerobic fermentation and are generally caused by the presence of sulfur and nitrogen containing compounds, fatty acids, esters and naturally occurring hydrocarbons. Odor control may be best carried out by efforts to keep the material aerobic, to avoid disturbance of anaerobic material and to provide coverings which prevent gaseous emission; by camouflaging the smell to make it acceptable; and by oxidation of the malodorants to the odorless end products of carbon dioxide and water. If a method of oxidation is chosen, then financial, energy and space requirements, in addition to volume and concentration of odor and efficiency of odor reduction required will dictate the method to be used. There is evidently a need for further study in the chemical nature of odorants associated with solid waste degradation. While sensory methods for assessing the level of oxidant odorants are now well stabilized, the results they give are necessarily subjective. Instrumental analytical techniques must be developed to chemically identify the major constituents of the odor and hence enable a suitable method of abatement or eradication to be used. (Baker-IVI)
W84-01564

RECLAMATION OF WASTEWATER CONSTITUENTS BY ION EXCHANGE, PART I. REVIEW OF FLOWSHEETS FOR THE PROCESSES - CONTINUED FROM VOLUME 23 NUMBERS 1 AND 2,
B. A. Bolto, and L. Pawlowski.
Effluent and Water Treatment Journal, Vol. 23, No. 4, p 159-167, April, 1983. 6 Fig, 3 Tab, 56 Ref.

Descriptors: *Reclaimed water, *Ion exchange, *Metal finishing wastes, Nickel, Copper, Mercury, Heavy metals, Zinc, Molybdenum, Selenium, Arsenic, Resins.

The typical ion exchange system for recycling the constituents of rinse water coming from chromic and cyanide operations of metal finishing plants consists of a cation exchanger unit followed by an anion exchange unit. The recovery of metals is possible when the streams of rinse water to be treated are separated, allowing the regeneration effluents to be appropriately mixed. Another method of treatment is to separate some of the heavy metals from the mixture. With conventional resins it is possible to obtain selective removal of heavy metals from effluents. Specific resins for the selective removal of ions are also known. The biggest environmental problem associated with nickel arises from metal finishing plants where its recovery is possible only if the nickel-bearing effluent is separated from other effluents. There are several copper baths which contain sulfate or chloride, and the general concept of their treatment is as for the treatment of nickel bearing effluents. Another application of ion exchange for the recovery of copper is the treatment of effluents from leaching operations in copper production. For removal of zinc, the zinc cation may be taken up by a cation exchanger or a chelate resin, and the anion by an anion exchanger. Most of the mercury resulting from industrial waste comes from chlorine and caustic manufacturing plants. Re-use of mercury from the wastewater treatment can reduce the cost of treatment by about 25%. Recovery of precious metals and rare elements is also possible. (Baker-IVI)
W84-01568

FLOCCULATION TEST METHODS,
University Coll., London (England). Dept. of Civil Engineering.
J. Gregory.
Effluent and Water Treatment Journal, Vol. 23, No. 5, p 199-205, May, 1983. 3 Fig, 35 Ref.

Descriptors: *Flocculation, *Testing procedures, Zeta potential, Colloids, Sedimentation, Permeability, Electrophoresis, Jar testing, Chemical coagulation, Water treatment, Wastewater treatment.

The essential steps in the flocculation of a water containing suspended particles are destabilization of the particles by eliminating any repulsion between them, and collisions of destabilized particles to form aggregates, or flocs. Proper operation of a flocculation process requires that the correct dosages of reagents be used, with efficient mixing, and that the destabilized particles are provided with sufficient contact opportunity to form aggregates of the required size and properties. The flocculation test procedure establishes the optimum chemical conditions for floc formation. Ideally the test procedure should simulate the operation of a full-scale unit and be capable of predicting plant performance on the basis of laboratory trials. Measurement of the particle charge as a function of reagent dose can give a good indication of the optimum dosage. The most common approach is to measure the zeta potential of the particles. Another technique which can give similar information without the use of elaborate equipment is colloid titration. This test depends on the fact that water-soluble polyelectrolytes of opposite charge to the suspension particles will adsorb strongly until the particle charge is neutralized. Properties of flocculated suspensions which should be determined include sedimentation and permeability. The jar test procedure can be used to determine many of the properties of the flocculated suspensions. However, such testing has disadvantages, including time consumed to complete the test procedure. Alternatives to the jar test are being developed with two different aims: to provide a test method which is more rapid and convenient giving information on optimum chemical conditions; and to give result which are more closely related to flocculation performance in actual flocculation plants. (Baker-IVI)
W84-01570

A COMPARISON OF AN INDUSTRIAL AND DOMESTIC SEWAGE,
T. Stones.
Effluent and Water Treatment Journal, Vol. 23, No. 5, p 206-207, May, 1983. 4 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Design criteria, Effluents, Industrial wastes, Domestic wastes, Biochemical oxygen demand, Oxygen demand.

The relative strengths of industrial vs domestic sewages have been expressed in terms of various criteria. The anomalies in results are due to differences in the extent of oxidation of the two sewages under the conditions of the various determinations. During the determination of the chemical oxygen demand there is virtually complete oxidation of the carbonaceous matter so that this gives an absolute value for the total carbonaceous oxygen demand and hence provides a basis with which the other criteria can be compared. The 5-days biochemical oxygen demand thus represents 54.2% of the total carbonaceous oxygen demand in the case of the domestic sewage but only 37.2% thereof in the case of the industrial sewage which is relatively 31.4% less, while the permanganate value represents 10.1% of the total carbonaceous oxygen demand in the case of the domestic sewage but 13% thereof in the case of the industrial sewage which is relatively 28.7% more. A substantial amount of the carbonaceous matter present in sewage that is inert to biochemical oxidation under the normal conditions is removed during the course of treatment and so constitutes a significant part of the oxidizable load imposed upon a biological oxidation plant. The use of the 5-day BOD as a basis for determining the capacities of such plants is therefore illogical as it leads to the paradoxical situation in which plants of smaller capacity are thereby calculated as being necessary for the treatment of intractable industrial sewages than for those intended to deal with equal volumes of domestic sewages readily amenable to treatment. (Baker-IVI)
W84-01571

RECLAMATION OF WASTEWATER CONSTITUENTS BY ION EXCHANGE; PART I REVIEW OF FLOWSHEETS FOR THE PROCESSES - CONTINUED FROM VOLUME 23 NUMBERS 1, 2 AND 4,
B. A. Bolto, and L. Pawlowski.
Effluent and Water Treatment Journal, Vol. 23, No. 5, p 208-213, May, 1983. 6 Fig, 24 Ref.

Descriptors: *Recycling, *Ion exchange, *Wastewater renovation, Municipal wastes, Dye industry, Industrial wastes, Agricultural wastes, Waste recovery, Regeneration, Minerals, Phosphates, Nitrates, Water reuse.

The concentration of solutions by evaporation produces condensates which may contain several to a few thousand milligrams of solute per liter. An ion exchange method can be used for recycling the chemicals and the water from the condensate. One of the best known examples is the recycling of condensate constituents from the fertilizer industry. The most important factor affecting the economics of ion-exchange methods is the concentration of the regeneration effluent; special columns are used to increase its concentration. The main problem in the system is to ensure uniform flow of the regeneration effluent through the ion-exchange bed. If regeneration effluents containing (NH4)2SO4 are introduced into the processing of ammonium nitrate, the durability of the ammonium nitrate granules is increased which improves their quality as a fertilizer. The removal of nutrients from wastewaters becomes a very important goal to ensure survival of water supplies. An interesting attempt to use ion exchange for the recovery of ammonium and phosphate ion is based on the selective adsorption of ammonium ions on clinoptilolite and of phosphate on an anion exchanger, and on the precipitation of MgNH4PO4 from the regeneration effluent. Another approach uses nitric acid and ammonia to regenerate an ion exchanger bed for the tertiary treatment of effluents. The regeneration effluent, being a mixture of ammonium and nitrate salts, is used as a fertilizer. Ion exchange methods have recently been used in recovering organic compounds from wastes such as the separation of sulfonic and sulfuric acids. In the dyeing of acrylic fibers with cationic dyes, the used dye bath and wash liquors are recycled through a three-column system: activated charcoal followed by two cation exchanger beds in the H-form. Recovered water is recycled. Recovery of water from brackish agricultural and municipal wastewater has also been proposed. The regeneration effluent from ion exchange softening plants can also be reused. (Baker-IVI)
W84-01572

A REVIEW OF ACTIVATED SLUDGE TREATMENT; PART I,
M. S. Ray.
Effluent and Water Treatment Journal, Vol. 23, No. 6, p 225, 227-229 and 231-232, June, 1983. 3 Fig, 5 Tab.

Descriptors: *Activated sludge process, *Wastewater treatment, Oxygen, Oxidation, Unox process, Cost analysis, Bacteria, Aeration tanks, Nitrification, Microorganisms.

A concise summary of the nature of the activated sludge treatment process is presented along with a discussion of the use of pure oxygen for treatment, a description of the Unox process with useful data and associated costs, and the mention of oxygenation systems other than tank-based processes. A wide variety of microorganisms are found in activated sludge including bacteria, filamentous growths, algae and protozoa. There is a favorable range of pH over which bacterial activity is at a maximum, and deviations result in a reduction of efficiency. An aeration system is generally used to dissolve oxygen in the liquid, strip out carbon dioxide, mix aerated liquid and bacterial sludge, and maintain solid matter in suspension. Two major types of systems include the diffused air system and the mechanical aeration system. Potential advantages of the use of oxygen in place of air for activated sludge treatment have been studied. Potential advantages include efficient oxygen dissolution and increased biomass concentration. Potential disadvantages of an oxygen system include the effect of high dissolved oxygen levels, sludge settling rates, excess sludge generation, higher MLSS levels, nitrification, shock loads, bulking, sludge thickening, power consumption, and capital cost. (Baker-IVI)
W84-01573

RECLAMATION OF WASTEWATER CONSTITUENTS BY ION EXCHANGE; PART II REVIEW OF CONTACTING EQUIPMENT,
B. A. Bolto, and L. Pawlowski.
Effluent and Water Treatment Journal, Vlo. 23, No. 6, p 233-239, June, 1983. 13 Fig, 25 Ref.

Descriptors: *Recycling, *Waste recovery, *Water reuse, *Ion exchange, Regeneration, Wastewater treatment.

The application of ion-exchange reclamation systems to recycling is considered. Application has historically been divided into moving-bed systems and fixed-bed systems. The moving bed systems may be further divided into cocurrent and countercurrent systems. Countercurrent moving bed systems may be divided into semicontinuous and truly-continuous systems which make use of a compact or fluidized bed. Fixed bed systems may be divided into cocurrent and countercurrent versions, in compact or fluidized bed formats. Another feature which distinguishes the various contacting methods is the sequence and direction of flows through the various process units during loading and regeneration. Use of a moving bed allows one to perform continuous ion-exchange operations which are attractive because of their processing efficiency and their similarity to continuous solvent extraction or distillation. While the fixed bed systems perform reliably in many types of effluent treatments, in the treatment of wastewater one very often has to deal with high turbidity solutions and liquids having a high concentration of solutes. In such cases continuous countercurrent fluidized systems can provide more efficient performance. When the effluent to be treated has a high level of turbidity the CSIRO concept of a continuous apparatus based on magnetic resins can be very useful. The proper selection of contacting equipment for carrying out ion exchange processes in effluent treatment is c
(Baker-IVI)
W84-01574

TREATMENT OF OLIVE OIL WASTE DISTILLATION,
M. C. Annesini, A. R. Giona, F. Gironi, and Pochetti.
Effluent and Water Treatment Journal, V
No. 6, p 245-248, June, 1983. 2 Fig, 5 Tab,

Descriptors: *Wastewater treatment, *Distil *Olive oil, Industrial wastes, Food-proc wastes.

A method is proposed for the physico-ch characterization of the wastewater effluent olive oil mills by means of batch distillatio The experimental results allow individual eq um ratios and initial concentrates of three p compounds which can be used to descrit behavior of vegetable waters in an industrial lation process. The method can be applied to industrial effluents with characteristics sim those of vegetable waters. In the production there are two consecutive centrifugations, first of which the cake is separated from the phase while in the second the oil is separated the water. The vegetable waters are useles dues with strong pollution potential. Treatm such waters is conditioned by its characte the high organic loading expressed in ter COD or BOD, the discontinuity caused b seasonal processing of olives, and the low flo due to the small capacity of the oil mills. Con ly used processes to deal with the problem ir aerobic biological processes, chemical pro based on the precipitation of pollutants, and cal processes. The physicochemical charact tion of the effluent is considered. On the ba the findings of a study of batch distillation, a evaluation of the distribution of pollutant pounds between the liquid and the vapor ph possible. A distillation treatment process is su ed. Experimental runs were carried out. values of the equilibrium ratio of three ps compounds and their temperature depen have been determined. (Baker-IVI)
W84-01576

INGESTION AND ASSIMILATION RATE OOCYSTIS SP. BY DAPHNIA MAGNA TREATED WASTEWATERS,
Laval Univ., Quebec. Dept. de Biologie.
B. Myrand, and J. de la Noue.
Environmental Pollution, (Series A) Vol. 31 3, p 77-95, June, 1983. 6 Fig, 1 Tab, 48

Descriptors: *Biological wastewater treat *Daphnia, *Oocystis, Nutrient removal, Phytoplankton.

Although the effluent from the sewage treat plant is an improvement over untreated eff this discharge is still rich in nutrients which a erate the eutrophication of the collector strea has been proposed that the fertilizer potenti these wastewaters could be used to produce through the controlled growth of phytoplan This study was aimed at examining the possi of using Daphnia magna to recover the pl plankton produced in high concentration du the biological treatment of wastewaters. Inge rate, assimilation rate and assimilation effici were measured for Daphnia grown under trolled experimental conditions in secondary ed wastewaters. The rate of ingestion was hi at 15 C than at 20 C and depended on the con tration of algae (Oocystis sp.) used: 10 and 50 C/l. The rate of assimilation was constant at a 1-8 micro g C per Daphnia per hour. It is prop that the incipient limiting level of ingestion co sponds to the concentration where the assimila rate is maximum. At food concentrations hi than this level of ingestion, Daphnia control m anisms normally maintain a constant ingestion and prevent superfluous feeding. These res however, revealed the inefficiency of these me nisms at high food concentrations, leading Dap to superfluous feeding. Nevertheless, Daphni

tself as a good candidate for the filtration of tis produced in wastewaters. (Moore-IVI) 1590

RNATIVE POLICY INSTRUMENTS R UNCERTAINTY: A PROGRAMMING EL OF TOXIC POLLUTION CONTROL,
Systems, Inc., Cambridge, MA.
lorgan.
l of Environmental Economics and Manage- Vol. 10, No. 3, p 248-269, September, 1983. 28 Ref.

ptors: *Wastewater treatment, *Industrial ater, *Regulation, Water pollution control, finishing wastes, Mathematical models, Pric- conomic aspects, Bridgeport, Connecticut.

gramming model was developed which ex- the relative performance of different regu- regimes under uncertainty in controlling wastes discharged by industry to a central ent plant when the central plant is subject to old-type losses in treatment performance. egulatory regimes are examined: non-market y, price, marketable permit, and mixed uantity. The theoretical framework of the is based on the analysis of prices vs quanti- Weitzman in 1974 and its extension to the a discontinuous threshold effect. The data re based on the situation of Bridgeport, cticut, which has a number of metal finish- ns. The strong points of the model include a cation of uncertainty based on econometric an ability to model a variety of sophisticat- ulatory environments, a materials-balance ch which accounts for all liquid and solid s, specification of recycling and flow reduc- well as end-of-pipe treatment capabilities ns, and explicit use of environmental impact ns rather than quantity standards. All three regimes perform much better than the non- quantity regime if discharge benefits are elated across firms. (Moore-IVI) 1609

EVITY OF SALMONELLA TYPHIMUR- N TILAPIA AUREA AND WATER FROM S FERTILIZED WITH SWINE WASTE,
n Univ., AL. Dept. of Fisheries and Allied ultures.
mary bibliographic entry see Field 5B. 1655

LING STRATEGY FOR DETECTING ES IN A SEWAGE TREATMENT T,
-l Univ. (France). Lab. d'Hygiene et de che de la Sante Publique.
land, J. C. Joret, F. Villeval, J. C. Block, Hartemann.
d and Environmental Microbiology, Vol. 45 p 1767-12774, June, 1983. 3 Fig, 10 Tab, 20

ptors: *Wastewater treatment, *Viruses, ing, Activated sludge process, Enterovir- Coliforms, Chemical oxygen demand, Bio- al oxygen demand, Suspended solids, Raw ater, Biological wastewater treatment, variation, Nancy, France.

y of pollutant flows was carried out at a ater treatment plant in Nancy, France, used activated-sludge treatment. The plant s 150,000 cu m of sewage daily from a -inhabitant community. A comparison be- two methods of sampling was conducted: nples every 2 h over a period of 24 h and -h composite sample were taken from raw ated wastewater and then analyzed for en- uses, fecal coliforms, chemical oxygen d, biochemical oxygen demand, and sus- solids. The results showed that the hourly ons of these pollutants in the effluents are in greement with expectations based upon the ers' usage and the characteristics of the ater network. Significant correlations were between all tested parameters and enterovir- raw wastewater. After biological treatment, no correlation remained in treated wastewater between viruses and other parameters. As for the two sampling methods, a rather good representation of the daily load was given by the composite mode of sampling as concerns physicochemical and microbiological parameters. Biological treatment removed an average of 83% of viruses. A minimum of 300,000,000 PFU of enteric viruses are discharged daily from this plant. (Moore-IVI)
W84-01659

ELECTRON MICROSCOPIC EXAMINATION OF WASTEWATER BIOFILM FORMATION AND STRUCTURAL COMPONENTS,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
T. T. Eighmy, D. Maratea, and P. L. Bishop.
Applied and Environmental Microbiology, Vol. 45, No. 6, p 1921-1931, June, 1983. 7 Fig, 52 Ref.

Descriptors: *Biofilms, *Wastewater, *Bacteria, Glycocalyx, Matrix, Electron microscopy.

A biofilm is an assemblage of bacterial cells that is both enclosed by and attached to a wetted surface by means of an extracellular fibrous polysaccharide-containing matrix, termed a glycocalyx. In situ wastewater biofilm formation, structure, and physicochemical properties were studied by scanning and transmission electron microscopy. Cationized ferritin was used to label anionic sites of the biofilm glycocalyx for viewing in thin section. Wastewater biofilm formation paralleled the processes involved in marine biofilm formation. Scanning electron microscopy revealed a dramatic increase in cell colonization and growth over a 144-h period. Constituents included a variety of actively dividing morphological types. Many of the colonizing bacteria were flagellated. Filaments were seen after primary colonization of the surface. Transmission electron microscopy revealed a dominant gram-negative cell wall structure in the biofilm constituents. At least three types of glycocalyces were observed. The predominant glycocalyx possessed interstices and was densely labeled with cationized ferritin. Two of the glycocalyces appeared to mediate biofilm adhesion to the substratum. The results suggest that the predominant glycocalyx of this thin wastewater biofilm serves, in part, to enclose the bacteria in a matrix and anchor the biofilm to the substratum and provide an extensive surface area with polyanionic properties. (Moore-IVI)
W84-01661

IMPROVED EVAPORATORS FOR RADIOACTIVE WASTES,
Graver Co., Union, NJ. Unitech Div.
D. Anthony.
Chemical Engineering Progress, Vol. 79, No. 7, p 58-63, July, 1983. 3 Fig, 5 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Radioactive wastes, *Ammonia, *Corrosion, Water reuse, Reclaimed water, Industrial wastes.

Evaporation can be an effective and economical means of treating radioactive waste in the nuclear plant. It reduces the waste volume through evaporation of the volatile solvent (water) resulting in a smaller volume and smaller mass of contaminated material for ultimate storage or disposal. Relatively pure water (condensed vapor), is recovered and can be recycled or reused within the plant or discharge to the environment with little or no additional treatment. One of the largest contributing sources of radwaste in a nuclear plant is the waste effluent produced in the regeneration of ion exchange resins. This waste typically consists of a solution of roughly 1-2% sodium sulfate in water. Difficulties in operating radwaste evaporators have stemmed mainly from corrosion, but new materials are being made which are more corrosion resistant. The chemical regeneration of demineralizer beds is accomplished by passing appropriate chemical solutions through the resin beds. The presence of significant amounts of ammonia and ammonia compounds in evaporator or crystallizer feed streams has recently been found to cause some potentially serious difficulties which can be classified into three categories: distillate quality, solidification considerations, and corrosion problems. To avoid these problems it is necessary to remove the ammonia from the feed before it enters the evaporator. This can be accomplished by raising the feed pH by the addition of NaOh to the feed tank, and processing the feed through a stripping column which removes the volatile ammonia by steam stripping. The system is effective in reducing the feed ammonia concentration by at least a factor of 200. (Baker-IVI)
W84-01665

TRANSFERABLE DISCHARGE PERMIT TRADING UNDER VARYING STREAM CONDITIONS: A SIMULATION OF MULTIPERIOD PERMIT MARKET PERFORMANCE ON THE FOX RIVER, WISCONSIN,
Colby Coll., Waterville, ME. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W84-01702

ACTIVATED SLUDGE TREATMENT OF SYNTHETIC WASTEWATER CONTAINING PENTACHLOROPHENOL,
Cornell Univ., Ithaca, NY. School of Chemical Engineering.
R. U. Edgehill, and R. K. Finn.
Biotechnology and Bioengineering, Vol. 25, No. 9, p 2165-2176, September, 1983. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Activated sludge process, *Pentachlorophenol, *Wastewater treatment, Industrial wastes, Wood treatment wastes, Pesticides, Wood preservatives, Arthrobacter, Phenols, Shock load.

Treatment of wood products with preservative formulations containing pentachlorophenol (PCP) often results in the generation of polluted effluents, and conventional activated sludge treatment of wastewaters containing PCP is inefficient and unreliable. With a synthetic waste containing some sugars, and 40-120 mg/l PCP, laboratory activated sludge required about seven days for acclimation. The prior addition of a quasipure culture of PCP-metabolizing Arthrobacter resulted in immediate acclimation. Even with acclimated sludge, the system was upset for two days by a simple step change from 40 to 120 mg/l of PCP. The stability of the system to such a shock load was considerably improved when a chemostat culture of the PCP-metabolizing Arthrobacter was fed slowly into the mixed liquor. Kinetic models were developed to describe the dynamic response of the system in terms of growth parameters, hydraulic detention time, sludge age, and bleed-in rate from the chemostat. (Moore-IVI)
W84-01757

FACTORS REGULATING THE DENSITY OF BACTERIA IN PROCESS WATERS OF A PAPER MILL,
Helsinki Univ. (Finland). Dept. of Microbiology.
P. Vaatanen, and S. I. Niemela.
Journal of Applied Bacteriology, Vol. 54, No. 3, p 367-371, June, 1983. 4 Tab, 8 Ref.

Descriptors: *Pulp and paper industry, *Process water, *Bacteria, Klebsiella, Acinetobacter, Pseudomonas, Water temperature, Hydrogen ion concentration, Redox potential, Finland.

Variations in the numbers of total colonies of Klebsiella pneumoniae, Acinetobacter spp. and pseudomonads were investigated in process waters of a paper mill in southern Finland. Variations were related to independent parameters, namely temperature, pH, redox potential and production of offset paper, by using multiple regression analysis. Temperature was the most significant regressor variable and was negatively correlated with bacterial counts. It accounted for up to about 80% of the variance in bacterial counts in various parts of the process. The significance of temperature was due to its fluctuations in a critical range, above and below the maxima for bacterial growth. The pH level was also significant for total colony count and for K. pneumoniae. Redox potential and the production of offset paper were of significance for

Acinetobacter spp. Washing the paper machine with water and lye decreased the numbers of bacteria in process waters. (Author's abstract)
W84-01766

5E. Ultimate Disposal Of Wastes

LAND TREATMENT OF HAZARDOUS WASTE,
A. Morrison.
Civil Engineering, Vol. 53, No. 5, p 33-38, May, 1983. 1 Fig, 3 Tab.

Descriptors: *Waste disposal, *Land disposal, *Organic compounds, Oils, Pesticides, Solvents, Inorganics, Hazardous materials, Waste management, Monitoring.

Land treatment, or land cultivation, is both controversial and promising. The controversy stems from the poor state of knowledge about the fate and transport of chemicals, especially hazardous ones, in the soil. In land treatment selected wastes are applied to a topsoil layer where they are broken down organically or immobilized. At some sites wastes were flood-irrigated onto the soil then allowed to dry. There are roughly 200 land treatment sites in operation, over 100 of them at refineries and almost all of them used by industrial concerns needing to dispose of their own wastes. Testing must be done to determine the suitability of the wastes before instituting operation of the system. Monitoring systems must be designed to determine the condition of the groundwater and the soil in the unsaturated zone beneath the treatment zone. In order for this management intensive process to function it is important to determine what types of wastes and what amounts are able to be so treated. Organics are probably better candidates for land treatment than inorganics. Particularly suitable are solvents, pesticides, and oils. System failure may result if wastes containing highly resistant or mobile compounds are applied as they may leach to the groundwater through a permeable soil layer. The most important of the EPA land regulations is that a demonstration pior to facility start up must be performed. (Baker-IVI)
W84-01480

MUTAGENICITY OF MUNICIPAL SEWAGE SLUDGES OF AMERICAN CITIES,
New York State Coll. of Veterinary Medicine, Ithaca. Dept. of Preventive Medicine.
J. G. Babish, B. E. Johnson, and D. J. Lisk.
Environmental Science Technology, Vol. 17, No. 5, p 272-277, May, 1983. 2 Tab, 26 Ref. 507 RR05462.

Descriptors: *Sludge, *Mutagenicity, Industrial wastes, Wastewater treatment, Chemical treatment, Municiple wastes.

Dichloromethane extracts of sludge samples from 34 cities were tested for mutagenicity by using the Salmonella/mammalian microsome assay. Of the 34 samples, 33 demonstrated a dose-related increase in revertants in at least 1 of the 5 tester strains; of these 33 samples, 12 were positive with 2 or more strains. Seventy-six percent of the positive samples required metabolic activation to demonstrate mutagenicity, while 18% were mutagenic with and without the S-9 fraction, and 6% were mutagenic only in the absence of any metabolic activation. No association existed between the independent variables percent industrialization, wastewater treatment scheme, and chemical additives when tested individually against mutagenicity. (Author's abstract)
W84-01499

WASTE SLUDGE TREATMENT - MORE PERFORMANCE FOR LESS MONEY,
J. Warden.
Effluent and Water Treatment Journal, Vol. 23, No. 4, p 140-143, April, 1983. 3 Fig.

Descriptors: *Sludge thickening, *Hydroxide, Sludge disposal, Wastewater treatment, Polymers.

When raw water is dosed with coagulant the coagulant hydroxide is precipitated. This precipitate forms loose, open floc structure which accumulates on the filter, necessitating backwashing to clean the system. Coagulant hydroxide is exceedingly difficult to dewater, and it arises at very low concentrations, averaging about 0.08% by weight. With polyelectrolites it is possible to form large flocs which settle rapidly and achieve a high rate of solids capture. When dosed into a sludge the polymer acts very rapidly. If the flocs are very small when the polymer is dosed, the long polymer chain molecules will link across and round them. This is done in practice by pumping the flow through an orifice plate to make the flocs very small just at the point where the polymer is dosed. The sludge produced was described as containing no free water because if it was left standing for several hours it did not thicken any more and no free water appeared on the surface. It appeared that all the water which could be removed had been squeezed out by the kneading action of the thickener rake. Between 1 and 2 parts of polymer was used per thousand parts of sludge solids by weight. The first plant to use this technology was commissioned in January of 1980. The waterworks produced 2 million gallons daily and the solids load is about 450 lb/day. The works effluent at about 0.3% solid is retreated in a 5 ft diameter continuous thickener at a polymer cost of less than 50 pence per day and dewatered in a small hand operated filter press on a 4 hr cycle, two pressings per day. (Baker-IVI)
W84-01565

OPERATIONAL EXPERIENCE USING H2O2 IN LANDFILL LEACHATE TREATMENT,
Interox Chemicals Ltd., Widnes (England).
J. A. L. Fraser, and N. Tytler.
Effluent and Water Treatment Journal, Vol. 23, No. 4, p 149-156, April, 1983. 2 Fig, 6 Tab, 19 Ref.

Descriptors: *Leachates, *Landfills, *Hydrogen peroxide, *Odor control, Waste dumps, Groundwater contamination, Lagoons, Sulfates, Bacteria, Seasonal variations, Cost analysis, England.

Some of the techniques employed in gaining control of a leachate problem at the Bray-on-Thames landfill site are reviewed. The site consists of a single large quarry bounded on three sides by residential development. The central area is subdivided into lagoons which have been used for storage of contaminated water comprising raw and diluted leachate originating from the worked and reclaimed areas. Principal objectives of the restoration included the control of sulfide odor emission from lagoon surfaces; improvement in the leachate quality sufficiently to meet the discharge criteria imposed by the Thames Water Authority; implementation of remedial site engineering to seal the surrounding perimeter ditch and stem ground water ingression; removal of misplaced land drains and re-alignment of surface contours over reclaimed areas to control leachate production and improve surface runoff. Seasonal variations in quality and quantity of leachate had to be considered as well as making every effort to expend only minimal capital costs for dosing equipment. Heavy duty, portable, diesel engines, vacuum primed pumps were chosen to move the leachate mass. Sulfide odors were controlled using a well-tried technique of surface treatment calling for placement of containers of peroxide every 20 m along the upwind banks of lagoons and allowing peroxide to drip into the water at 100 ml/min. (Baker-IVI)
W84-01567

5F. Water Treatment and Quality Alteration

NITRATES CONCENTRATION REDUCTION IN DRINKING WATER: EXTRA DETAILS ON BIOLOGICAL TREATMENTS (REDUCTION DES TENEURS EN NITRATES DANS LES EAUX DE CONSOMMATION: LE POINT SUR LES TRAITEMENTS BIOLOGIQUES),
J. M. Philipot, J. Sibony, G. Martin, and G. Blecon.
Aqua, No. 2, p 61-67, April, 1983. 4 Fig, 6 T Ref

Descriptors: *Water treatment, *Nitrates, *D ing water, Denitrification, Heterotrophic bac Filtration, Biological treatment, Anaerobic ment, Organic compounds.

The presence of nitrates in drinking wate subject of concern for the consumer. In Franc Supreme Health Authority has given a favo opinion on the development of a biological ess. This method uses the properties of some ria in anoxic conditions, to oxidize a carbona substrate, i.e. ethanol, and to reduce the nitra gaseous nitrogen. It is the heterotrophic pat High yields are obtained by cell-fixation of de fying bacteria on a specific mineral mediu post treatment including an aerated filtrati G.A.C. and a sand filtration is achieved in on through a BIOCARBONE filter: the nitrate tent of the raw water is then reduced to 25 mg the same way, organics and micropollutants, associated with nitrate pollution, are removed other biological treatment will soon be availab uses the autotrophic pathway of biological de fication. A reduced mineral substrate, i.e. gra sulfur, is used for nitrate reduction to ga nitrogen. A mixed bed of calibrated grains of s and calcium carbonate enhances the denitrific rate. Figures are given of the results of both esses with different kinds of raw water. (Aut abstract)
W84-01458

THE USE OF ACTIVATED ALUMINA DRINKING WATER TREATMENT: A LOGICAL REVIEW (UTILISATION DES MINES ACTIVEES COMME ADSORB DANS UNE FILIERE DE TRAITEMENT D' POTABLE: REVUE BIBLIOGRAPHIQUE-P SPECTIVE),
Ecole Nationale Superieure de Geologie A quee et de Prospection Miniere, Nancy (Fra Centre de Valorisation des Minerais.
J. Y. Bottero, F. Thomas, and A. Leprince.
Aqua, No. 2, p 69-73, April, 1983. 6 Fig, 4 Ta Ref.

Descriptors: *Activated alumina, *Water t ment, Drinking water, Adsorption, Regenera Wastewater treatment, Activated carbon, Coa tion, Polymerization, Organic compounds.

At present activated alumina cannot substitute activated carbon. However the specific adsorp and ease of regeneration of activated alu makes it a material worthy of deeper study. Po ising applications now being investigated inc the possibility of specific activation during pr ration and use in combined processes with ca or oxidation. For waste water it is possible aluminas which are less high grade materials activated carbons could find useful applica Activated aluminas are classified by temperat origin, and ,crystalline structure. The capacit remove mineral constituents is reported, an summary is given of the basic aspects of the moval of organics. In this latter case the s reported from the literature concludes that ads tion on alumina is complementary to that carbon because there is specific adsorption of p substances and those of high molecular we ease of regeneration by heat or by oxidation the possibility of surface action involving coag tion, adsorption and polymerization. Adsorp isotherms are given for activated alumina for cyclic acid, and octylbenzene sulfonate. It found difficult to compare these results with th for activated carbon but an isotherm for adsorp of benzoic acid on carbon is given. (Moore-I W84-01459

MANAGING COUNTYWIDE WATER SE ICES WITH SATELLITE SYSTEMS,
Economic and Engineering Services, Inc., Ol pia, WA.
R. L. Wubbena, and J. M. Maxwell.
Journal of the American Water Works Ass ation, Vol.75, No. 4, p 158-163, April, 1983. 1

LIBRARY U. OF I. URBANA-CHAMPAIGN

ors: *Utilities, *Water utilities, Legisla-
lity management, Economic aspects, Satel-
r systems, Washington.

on in the state of Washington has pro-
ne impetus for developing cooperative
ide water services. The long-term im-
nt program permits small satellite water
to operate under the aegis of established
t the level of assistance necessary to meet
ry requirements and to provide cost-effec-
able service to customers. A countywide
nent program for operation of satellite
stems requires: identifying existing system
reas and accepting responsibility for meet-
imum standards of service; identifying
tems that do not have the management or
resources to provide adequate service;
tifying an agency with the authority and
ss to assume the responsibility of a satel-
gement agency. The objective is to devel-
g-term, slow-paced improvement program
systems that will gain public support and
omers through demonstrated patience and
(Moore-IVI)
18

IZING AND MANAGING SOUTH DA-
RURAL WATER SYSTEMS,
akota Association of Rural Water Sys-
ux Falls.
vis.
of the American Water Works Associ-
l. 75, No. 4, p 164-167, April, 1983.

ors: *Rural areas, *Water utilities, Utili-
nomic aspects, South Dakota.

ter systems have been developed in South
within the past 12 years to provide suffi-
antities of good water to thousands of
ranchers, and small towns. Grass roots
s evolved into functioning water systems
eration among systems to improve serv-
nomically. The concept is expected to
a growing number of systems to serve the
rural population of South Dakota. (Au-
tract)
19

TIN AMERICAN APPROACH TO IM-
G WATER SUPPLIES,
nd Air Research, Inc., Gainesville, FL.
gner.
of the American Water Works Associ-
l. 75, No. 4, p 168-173, April, 1983. 10
b, 1 Ref.

ors: *Water treatment facilities, *Water
Administration, Government finance,
esign standards.

of supplying water for small cities and
Latin America is much less than in the
tates because of regional administration,
of financing, and simplified design of
plants. The regional organization,
federal or state, provides the managerial
nical skills for planning, designing, con-
and operating water systems. Financing,
rants, for small systems in Latin America
om the federal and state governments. The
treatment plants is based on obtaining the
production of good-quality water at the
ossible cost. This results in minimum use
nent and valves, maximum use of gravity,
ification of operation. (Moore-IVI)
20

ATING THE ECONOMICS OF ALTER-
TECHNOLOGY FOR SMALL WATER
S,
Roy F.), Inc., West Chester, PA.
b, and W. G. Richards.
of the American Water Works Associ-
l. 75, No. 4, p 177-183, April, 1983. 4 Fig,
Ref. ISP-80-15075.

ors: *Water utilities, *Water management,
ic aspects, Alternative planning, Cost
Model studies.

The WATerMANagement model (WATMAN) was expanded for application to small water systems serving populations of 100-10000 so that the economics of alternative solutions to meeting new water quality standards can be evaluated. Two hypothetical cases and two actual situations were tested with the model to select preferred water supply options. In all four cases, the WATMAN model identified cost-effective solutions and competitive alternatives through a present-value analysis. The ability of the model to incorporate site-specific characteristics, to develop preliminary designs, and to make economic estimates for individual communities was demonstrated. (Moore-IVI)
W84-01521

TETRACHLOROETHYLENE LEACHED FROM LINED ASBESTOS-CEMENT PIPE INTO DRINKING WATER,
Environmental Protection Agency, Boston, MA. Water Supply Branch.
C. D. Larson, O. T. Love, Jr., and G. Reynolds, III.
Journal of the American Water Works Association, Vol. 75, No. 4, p 184-188, April, 1983. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Pipe linings, *Tetrachloroethylene, Leaching, Water distribution, Vinyl toluene liners, Flushing, Continuous bleeders, Drinking water, Water pollution sources.

Tetrachloroethylene has been detected in concentrations ranging from a few micrograms per liter to several milligrams per liter in dead ends of water distribution systems made of vinyl-toluene-lined asbestos-cement pipe. About 1600 km (1000 mi) of this lined pipe is being used, primarily in New England. Tetrachloroethylene concentrations can be lessened by flushing and installing continuous bleeders, two of the solutions being suggested to correct this organics problem, which resulted from steps to control corrosion of asbestos-cement pipe. (Author's abstract)
W84-01522

VARIATIONS IN PARTICULATE MATTER, ALGAE, AND BACTERIA IN AN UNCOVERED, FINISHED-DRINKING-WATER RESERVOIR,
Association of Bay Area Governments, Berkeley CA.
G. S. Silverman, L. A. Nagy, and B. H. Olson.
Journal of the American Water Works Association, Vol. 75, No. 4, p 191-195, April, 1983. 1 Fig, 3 Tab, 30 Ref.

Descriptors: *Drinking water, *Finished-water reservoirs, *Water quality, Particulate matter, Algae, Bacteria, Turbidity, Chlorination, Particle size, Coliforms, Copper, Iron.

Physicochemical and microbiological analyses were performed on influent and effluent samples taken from Garvey Reservoir (Los Angeles County, California). Data collected on particle counts and size distributions, total plate count, coliform bacteria, algal counts, chlorophyll, turbidity, copper, and iron were analyzed with a computerized statistical package. The quality of the influent was degraded through biological activity in the reservoir to produce a lower-quality effluent. Results indicated that algae were associated with increased turbidity and particulate levels and might enhance or support bacterial activity, including physical protection of bacteria against the effects of chlorination. (Author's abstract)
W84-01523

FREE CHLORINE VERSUS AMMONIA-CHLORINE: DISINFECTION, TRIHALOMETHANE FORMATION, AND ZOOPLANKTON REMOVAL,
R. P. Mitcham, M. W. Shelley, and C. M. Wheadon.
Journal of the American Water Works Association, Vol. 75, No. 4, p 196-198, April, 1983. 3 Fig, 6 Tab, 2 Ref.

Descriptors: *Chlorination, *Disinfection, Ammonia-chlorine, Residual chlorine, Trihalomethanes, Zooplankton, Copepods, Cladocera, Water treatment, Halogenated hydrocarbons.

The relative efficiency of ammonia-chlorine and free residual chlorine in the treatment of lowland river water was studied. The roles of these chemicals in trihalomethane (THM) formation, water disinfection, and zooplankton removal were considered. Use of ammonia-chlorine reduced THM formation by as much as 80% and did not impair water disinfection. Compared with free residual chlorine, ammonia-chlorine was more effective against Copepoda (Cyclops) but less effective against Cladocera (Daphnia and Bosmina). (Author's abstract)
W84-01524

TREATING SURFACE WATERS FOR COMMUNITIES IN DEVELOPING COUNTRIES,
United Nations Development Programme, Washington, DC. Interregional Program.
C. R. Schultz, and D. A. Okun.
Journal of the American Water Works Association, Vol. 75, No. 5, p 212-219, May, 1983. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Water treatment, *Developing countries, Coagulation, Surface water, Economic aspects, Water treatment facilities, Maintenance, Operating costs.

Water treatment plants in developing countries should use simplified technologies that require little automation or mechanization to lower capital costs significantly. Operations and maintenance should also be less costly and more suitable for local labor conditions. Only as a last resort should chemical coagulation and rapid filtration be adopted. Mechanical equipment should be limited as much as possible to that produced locally. Hydraulic devices that use gravity are preferred over motor-driven equipment. The plant must be designed to treat the raw water available. Use can be made of natural coagulants derived from plants and animals to reduce the cost of treatment. Coagulation aids are effective at high turbidity levels, with possible savings of 40-50% in alum consumption. (Moore-IVI)
W84-01526

SIMPLIFYING DESIGN OF WATER TREATMENT PLANTS FOR DEVELOPING COUNTRIES,
Water and Air Research, Inc., Gainesville, FL.
E. G. Wagner.
Journal of the American Water Works Association, Vol. 75, No. 5, p 220-223, May, 1983. 1 Tab, 1 Ref.

Descriptors: *Water treatment facilities, *Developing countries, Economic aspects, Water treatment, Operating costs.

In the developing world, there is an acute shortage of money, managerial and technical skills, skilled labor, and well-organized, stable institutions. Therefore, water treatment plants in developing countries should be low in first cost and easy and economical to operate. The development of this kind of plant begins with a search for the best water source, includes determining the most effective treatment process, and continues through designing the plant. In water treatment plant design, there must be a conscious effort to minimize equipment, to maximize the use of gravity and hydraulics in the treatment process, and to make use of labor rather than equipment in the operation of the plant wherever possible. (Moore-IVI)
W84-01527

OVERVIEW OF RURAL WATER AND SANITATION PROGRAMS FOR LATIN AMERICA,
Agency for International Development, Washington, DC. Water and Sanitation for Health Project.
D. Donaldson.
Journal of the American Water Works Association, Vol. 75, No. 5, p 225-231, May, 1983. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Developing countries, *Water treatment, *Wastewater treatment, Rural areas, Economic aspects, Training, Human populations, Administration, Financing.

Though many rural inhabitants of Latin America now have access to safe water, millions remain unserved, and increasing populations place added stress on existing systems. Improvements are still greatly needed in administration and financing of water and sanitation projects and for extensive training programs for paraprofessional rural water technicians. (Author's abstract)
W84-01528

FERRIC CHLORIDE AND ALUM AS SINGLE AND DUAL COAGULANTS,
Air Force Hospital, Wurtsmith AFB, MI.
P. N. Johnson, and A. Amirtharajah.
Journal of the American Water Works Association, Vol. 75, No. 5, p 232-239, May, 1983. 9 Fig, 1 Tab, 23 Ref.

Descriptors: *Coagulation, *Alum, *Ferric chloride, Water treatment, Wastewater treatment.

A design-and-operation diagram for Fe(III) coagulation has been developed by using empirical work and information in the literature about coagulation. This diagram is compared with a previously developed design-and-operation diagram for alum coagulation. Empirical work has shown that combining alum and ferric chlorides as dual coagulants does not result in a more effective coagulant. (Author's abstract)
W84-01529

PREOZONATION AS A COAGULANT AID IN DRINKING WATER TREATMENT,
Saunier Eau et Environnement, St. Gregoire (France).
B. M. Saunier, R. E. Selleck, and R. R. Trussell.
Journal of the American Water Works Association, Vol. 75, No. 5, p 239-246, May, 1983. 16 Fig, 5 Tab, 6 Ref.

Descriptors: *Ozonation, *Flocculation, Water treatment, Basic aluminum chloride, Turbidity, Particulates, Chemical oxygen demand, Sedimentation.

The effects of preozonation on the treatment of Seine River water were evaluated in a pilot plant consisting of flocculation with basic aluminum polychloride (PAC) followed by sedimentation. Preozonation significantly increased the removals of turbidity, particle numbers and volumes, chemical oxygen demand, and UV absorbance at all treatment levels investigated (0.3-1.2 mg/L for ozone, and 15-60 mg/L for PAC), with the optimum ozone dose appearing to be about 0.8 mg/L. The favorable effects of ozone increased with pH and the particle count of the untreated water. The increases in particle removals appeared to stem partly from increases in floc size and settling velocity. (Author's abstract)
W84-01530

USING BY-PRODUCTS OF AN IRON REMOVAL PROCESS TO IMPROVE WATER TREATMENT,
Curry and Associates Engineers, Inc., Nashville, IL.
M. D. Curry, and M. Reynolds.
Journal of the American Water Works Association, Vol. 75, No. 5, p 246-248, May, 1983. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Water treatment, *Iron, *Manganese, Oxidation, Coagulation, Backwash reclamation, Corrosion, Hydrogen ion concentration, Potassium permanganate, Ferric hydroxide.

A conventional treatment for removing iron and manganese from groundwater was used by the village of Roxana, Ill., but the process did not reduce concentrations of these metals to recommended maximum levels. After using temporary measures, the village began looking at several long-term alternatives to solve the water quality problems. Of the alternatives considered, oxidation and removal of manganese with potassium permanganate was investigated further in bench studies. Modification of full-scale treatment effected the removal of manganese by using permanganate feed, ferric hydroxide from the reaction basin as a primary coagulant, and a cationic polymer as a coagulant aid. Reclamation of backwash eliminated a potential problem with disposal of the backwash. Both manganese and iron were reduced to acceptable levels. In addition, the increase in pH helped decrease corrosive water conditions in the distribution system, and the duration of filter runs was lengthened. (Author's abstract)
W84-01531

REMOVING NONVOLATILE ORGANIC CHLORINE AND ITS PRECURSORS BY COAGULATION AND SOFTENING,
Los Angeles County Sanitation Districts, Whittier, CA.
D. E. Johnson, and S. J. Randtke.
Journal of the American Water Works Association, Vol. 75, No. 5, p 249-253, May, 1983. 9 Fig, 5 Tab, 26 Ref. NSF-ENG-7908187.

Descriptors: *Chlorinated hydrocarbons, *Coagulation, *Water softening, Chlorination, Water treatment, Organic matter, Alum, Lime, Fulvic acid, Total organic chlorine, Chloroform, Hydrogen ion concentration.

Chlorine added to a potable water supply for disinfection will react with naturally occurring and anthropogenic organic matter present in the water to form volatile and nonvolatile halogenated organic by-products that represent a potential health hazard. In order to evaluate the potential of conventional water treatment to remove nonvolatile organic chlorine and its precursors, samples of groundwater, surface water, secondary effluent, and fulvic acid were treated in laboratory experiments by alum coagulation and lime softening in conjunction with prechlorination and postchlorination. Coagulation and softening both removed significant amounts of nonvolatile organic chlorine, precursors of organic chlorine, and total organic carbon (TOC). Organic chlorine precursors were removed as well as or better than TOC and much better than the organic chlorine formed during prechlorination. The increase in pH during lime treatment hydrolyzed a significant fraction of the nonvolatile organic chlorine, releasing chloroform and other by-products. (Moore-IVI)
W84-01532

USING BACKWASHING KINETICS TO EVALUATE ATTACHMENT MECHANISMS AND FORCES DURING FILTRATION,
SWEHELL Co. Ltd., Athens (Greece).
G. Toregas.
Journal of the American Water Works Association, Vol. 75, No. 5, p 254-260, May, 1983. 8 Fig, 3 Tab, 6 Ref.

Descriptors: *Filtration, *Coagulation, Backwash, Kinetics, Deep-bed filtration, Alum, Particle size, Mathematical models, Particle agglomeration, Filters.

A method is offered for evaluating the various models involved in particle removal from water by means of deep-bed filtration. Based on backwashing kinetics, this method takes into account the mechanisms associated with particle attachment (with and without alum treatment), particle agglomeration, and particle detachment. When the particle to grain size ratio (dp/dm) is greater than 0.055 straining appears to be important. For dp/dm ratios between about 0.040 and 0.055, straining appears to be significant; at dp/dm ratios below about 0.040, straining apears to be insignificant. The contribution of particle-medium interactions to the overall filter deposit was about constant (35% of total particle removal), whereas the contributions of the particle-particle interactions appears to depend on whether straining is significant. For filtration to be effective, particle-particle interactions should be predominant (accounting for as much as 65% of the total particle removal). The relative magnitude of attachment forces associated with collisions between particles and filte
and with the formation of agglomerates
from alum treatment prior to filtration was
ed by using backwashing recovery data.
tachment force acting during formation o
glomerate depends on size rather than zet
tial. (Moore-IVI)
W84-01533

CONDENSATE POLISHING,
J. R. Emmett.
Effluent and Water Treatment Journal,
No. 6, p 241-243, June, 1983. 4 Fig, 4 Ref.

Descriptors: *Water treatment, *Conc
Resins, Contamination, Design criteria,
plants, Water quality control, Cooling wate

Condensate polishing refers to the purific
power station turbine condensate to ensure
ed water quality which is acceptable as fee
to modern high pressure steam plants in th
generation industry. The main danger is the
of cooling water into the condensate. This
major problem as a condenser ages due to
or corrosion, bringing about pinhole perf
in the tube material. A second source of
sate contamination can be due to maloper
the power station make-up plant, permittin
rectly treated make-up water into the feed
A further problem may be the solution of
pheric carbon dioxide in the feed water
tanks. Soluble impurities may also be pres
lishing equipment is to remove both solu
insoluble impurities. The tendency is to
mixed bed deionization process, comprise
intimate mixture of cation and anion e
resins. The avoidance of regenerant cross c
nation is a matter of engineering design. It i
undesirable to introduce chemical regenera
a turbine room because of the danger o
feed-line contamination. Because high flo
are used in the condensate polishing proc
bed depth has to be limited in order t
pressure loss across the plant is maintain
satisfactory value. The degree of resin cr
tamination is very much influenced by cha
resin charge volume. Such changes mean
cation/anion interface level after separatio
in respect to the level of the anion resin
point and sluicing jet position. To solve th
lem of resin cross contamination, Kennicot
oped the Consep system, in which a ve
degree of resin separation is achieved. (Bak
W84-01575

THE INTERPRETATION OF CON CHROMATOGRAMS BY COMPUTER A SIS,
Anglian Water Authority, Huntingdon (En
For primary bibliographic entry see Field 5.
W84-01673

WATER DECHLORINATION BY ACTIV CARBON, ULTRAVIOLET RADIATION SODIUM SULPHITE; A COMPARISO TREATMENT SYSTEMS SUITABLE FO CULTURE,
Department of Fisheries and Oceans, W
(Manitoba). Freshwater Inst.
M. A. Giles, and R. Danell.
Water Resources, Vol. 17, No. 6, p 667-67
1983. 4 Fig, 5 Tab, 21 Ref.

Descriptors: *Dechlorination, *Activated
*Ultraviolet radiation, *Sodium sulfite,
treatment, Filtration, Pilot plant, Municipal
Toxicity, Chlorine, Halogenated hydrocarbo

Many research facilities rely on municipal
supplies as a source of dilution water for
toxicity investigations or for rearing and s
aquatic organisms, but chlorine, common
ployed as a disinfectant, is highly toxic to
freshwater organisms. The characteristics o
dechlorination by activated carbon filtratio
irradiation and sodium sulfite injection were
ined. A pilot plant water treatment systen
posed of sand and diatomaceous earth fil

tion and activated carbon filtration was eval-
Activated carbon did not completely elimi-
chlorine under any conditions tested but the
arbon chlorine concentrations were relative-
ensitive to large variations in incoming chlo-
evels and water flow rates. Carbon filtration
educed total dissolved organic carbon con-
tions by 65% and reduced various haloge-
methane derivatives by 97-100%. Ultraviolet
tion eliminated up to 99% of the total chlo-
municipal water but u.v.-dechlorination was
ve to flow rate with a rate constant of 2.02/
etween 10 and 271/min. Water temperatures
g from 7.5 to 20.6 C did not affect the
ncy of dechlorination by activated carbon or
radiation. Sodium sulfite at a 3:1 molar ratio
lorine completely eliminated chlorine from
ipal water while a sulfite:chlorine ratio of 6:1
equired to completely dechlorinate water
had been partially dechlorinated by activat-
bon. (Moore-IVI)
01681

TIONSHIP OF BACTERIAL COUNTS
TURBIDITY AND FREE CHLORINE IN
DISTRIBUTION SYSTEMS,
Reilly, and J. S. Kippin.
l of the American Water Works Associ-
Vol. 75, No. 6, p 309-312, June, 1983. 6 Tab,
. EPA grant R804724010.

ptors: *Water distribution, *Bacteria, *Tur-
*Free chlorine, Drinking water, Water
standards, Public health, Coliforms, Eco-
s, Encapsulation, Massachusetts, Salem,
y.

wo separate and distinct water distribution
s of Salem and Beverly, Massachusett,
have a common history and have met the
Public Health Services standards for a
on carrier since 1935, were comprehensively
to determine if certain aspects of the drink-
ter standards adequately controlled the qual-
finished water in the distribution system. The
ng points in both cities were faucets in
buildings located near the middle and ends
distribution system. A total of 2409 samples
llected over a 23 month period: 1157 sam-
om Salem, 1056 samples from Beverly, and
mples from the filtration plant used by both
The diversity of organisms identified by
standard plate count (SPC) and membrane
on strongly suggests an established microbial
tem in two distribution systems. The SPC
ed no relationship with coliform count
he SPC was less than 50 organisms/ml. The
as not dependent on low-level turbidity and
with respect to free chlorine residuals. The
ncy of coliform isolation was independent of
ty and free chlorine. Specifically, encapsu-
coliforms (Klebsiella pneumoniae, Entero-
cloacae, E. aerogenes, and E. agglomerans),
gave typical coliform results, exhibited the
to survive a free chlorine residual of 0.2
r more. Encapsulation was a major factor in
hese results. (Moore-IVI)
1754

Water Quality Control

ATE IN BRITISH WATERS,
al Water Council, London (England).
White.
No. 2, p 51-57, April, 1983. 6 Fig, 27 Ref.

ptors: *Nitrate, *Water quality control,
Britain, Standards, Water pollution sources,
ng water, Human diseases, Methemoglobin-

risks and water quality standards are dis-
for nitrate. The origin of nitrate in water is
ed as a background to rising concentrations
n rivers and groundwater. The identified
risk which was noted in the 1974 IWSA
tional Standing Committee on Water Qual-
l Treatment Report was methemoglobine-
nce that time the incidence of this problem
come rarer in Great Britain. Nitrate concen-
trations in both rivers and groundwater sources have been increasing and the problems could become worse before equilibrium is reached. The principal cause is changes in farming practices to enhance agricultural productivity. Opportunities for controlling nitrate sources are limited. Water treatment processes have been developed with a view to keeping nitrate concentrations in public supplies below 50 mg/l NO3. The viability of ion exchange has been established and problems in biological denitrification are being overcome. There is a possibility of substantial expenditure being required to reduce nitrate concentration but steps to deal with the problems in public supplies are well in hand. In Britain about 99% of the population receives water from the public supply systems. The most significant risks attached to nitrate lie with the small minority who rely on private supplies from shallow wells. (Baker-IVI)
W84-01456

NITRATE IN THE NETHERLANDS - A SERIOUS THREAT TO GROUNDWATER,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
W. V. Duyvenbooden, and J. P. G. Loch.
Aqua, No. 2, p 59-60, April, 1983. 1 Tab, 4 Ref.

Descriptors: *Nitrate, *Groundwater pollution, Water quality, Netherlands, Agricultural runoff, Soil properties, Drinking water, Fertilizers.

A nitrate problem exists in the Netherlands, in the sandy regions of the country located in the eastern and southern parts. Nitrate concentrations in the groundwaters are gradually rising, primarily due to agricultural activities. Particular in the bio-industrial areas, extremely high nitrate levels are found, extending deeply where there are aerobic conditions. A gradual deterioration has been detected in the quality of the groundwater. Without special measures being taken it is expected that in many cases nitrate levels in groundwater will in the long run rise above the European standards for drinking water. Serious attention will have to be given to measures to secure the supply of groundwater of a sufficient quality with respect to nitrate. At present no national regulations exist on the use of manure and fertilizers to protect groundwater. Some regional regulations have in principle the possibility of restricting the use of nitrogen in the protection zones around groundwater pumping stations, but in practice these rules are seldom complied with. (Baker-IVI)
W84-01457

NITRATE IN WATERS FOR HUMAN CONSUMPTION: THE SITUATION IN FRANCE (1979-1981). A STUDY BY THE FRENCH MINISTRY OF HEALTH, (TENEUR EN NITRATE DES EAUZ DESTINEES A LA CONSOMMATION HUMAINE: LA SITUATION EN FRANCE (1979-1981). ETUDE REALISEE PAR LE MINISTERE DE LA SANTE FRANCAIS: CADRE DE L'ETUDE).
Aqua, No. 2, p 74-78, April, 1983. 2 Fig, 7 Tab.

Descriptors: *Nitrates, *Groundwater, *Drinking water, *Regulations, France, Agricultural runoff, Well water, Groundwater contamination.

The French Ministry of Health has issued instructions on the attitude to be taken in regard to the presence of nitrate in drinking water. A survey was performed which revealed that 81% of the population has nitrate levels less than 25 mg/l and 96% to 98% has levels less than 50 mg/l in their drinking water supplies. Out of 53 million people approached in the survey, 280,000 at most have a water supply which exceeded 100 mg/l of nitrate at least once in the last three years. Out of the 20,000 distribution units surveyed about 1000 had nitrate above 50 mg/l and 61 only were about 100 mg/l. Most of the high nitrate areas were in the North and West of metropolitan France. Most of the high nitrates are found in groundwater, and most of the wells affected were in highly developed agricultural areas. Treatment by activated carbon is very effective but costly particularly because of regeneration whose frequency depends on speed of saturation of the carbon and thus on its place in the sequence of treatment. Based on a study of the physical chemical characteristics of aluminas suitable for industrial use, it is concluded that activated alumina cannot fulfil the role of activated carbon for drinking water quality control. However, because of the specific adsorption capacity and the ease of regeneration the use of activated alumina for the removal of organics is a subject which must be pursued. The possibility of specific activation during alumina preparation or alumina-carbon methods or alumina in oxidation treatment should be considered. (Baker-IVI)
W84-01460

INTERACTION OF CLAY SOILS WITH WATER AND ORGANIC SOLVENTS: IMPLICATIONS FOR THE DISPOSAL OF HAZARDOUS WASTES,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
W. J. Green, G. F. Lee, R. A. Jones, and T. Palit.
Environmental Science and Technology, Vol. 17, No. 5, p 278-282, May, 1983. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Clays, *Land disposal, *Hazardous materials, Waste disposal, Organic solvents, Partition, Interstitial water, Soil dehydration, Clay liners.

Studies of the behavior of three compacted, moist clay soils when immersed in water and in organic solvents have been conducted. The correlation between the logarithm of the octanol-water partition coefficient (log Kow) and the percent swelling of the clay soil suggests that swelling in these systems depends upon the transfer of immersion fluid into the clay soil pore waters. X-ray diffraction data obtained on air-dried clay soils treated with various liquids indicate that interlayer expansion does not occur in these systems. Slight shrinkage of clay soils in apolar, hydrophobic solvents such as carbon tetrachloride and xylene indicates that these liquids could damage the integrity of clay liners used for hazardous waste disposal pits. On the basis of these results, it is recommended that laboratory shrink-swell testing be conducted on samples of clay liners and representative waste mixtures and soils of the type to be encountered at a storage site. (Author's abstract)
W84-01500

SEEPAGE FROM OILFIELD BRINE DISPOSAL PONDS IN UTAH,
Colorado Univ. at Boulder. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W84-01552

ORGANIC MICROPOLLUTANTS IN WATER - A WHO VIEWPOINT,
J. I. Waddington.
Effluent and Water Treatment Journal, Vol. 23, No. 4, p 145-148, April, 1983. 1 Tab, 10 Ref.

Descriptors: *Hazardous materials, *Organic compounds, Toxicity, Quality control, Water quality, Guidelines, Regulations.

An increasing number of organic micropollutants are reaching the aquatic environment via sewage treatment plants and from industrial and agricultural activities. For many years the World Health Organization (WHO) has been developing health criteria related to the toxicity of chemical substances. Absolute safety is an impossible goal in relation to any aspect of life and a careful approach to risk assessment, cost-benefit and priority setting must be adopted if the major problems are to be satisfactorily overcome. The relationship between exposure and the spectrum of effects is referred to as the dose-response and an understanding of this relation constitutes a base for the study of toxicity. Dose-response curves have been developed for many chemicals, permitting the development of acceptable daily intakes (ADI) based on the non-observable adverse effects (NOAE) level. A problem with this approach lies with the duration of the NOAE level. There is uncertainty as to how long

such an intake can be tolerated without subsequent damage being sustained. (Baker-IVI)
W84-01566

EFFECT OF LOW LEVELS OF EXCHANGEABLE SODIUM AND APPLIED PHOSPHOGYPSUM ON THE INFILTRATION RATE OF VARIOUS SOILS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
Z. Kazman, I. Shainberg, and M. Gal.
Soil Science, Vol. 135, No. 3, p 184-192, March, 1983. 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Infiltration rate, *Sodium, *Soil crust, Arid regions, Lime, Phosphogypsum, Rain, Soil surface, Calcium carbonate, Soil solution, Electrolytes, Soil aggregates, Soil chemistry, Israel.

The arable soils in the arid and semiarid regions of Israel contain 2 to 6% exchangeable sodium in the upper layer. Considerable amounts of runoff and erosion from these soils, measured during rainstorms, have been associated with aggregate dispersion and crust formation at the soil surface. The effect of exchangeable sodium percentage (ESP) on the infiltration rate (IR) and crust formation of four soils, varying in their texture, mineralogy, and CaCO3 content was studied, using distilled water (EC approximately .05 mmho/cm) in a rain simulator. The IR of the four soils was very sensitive to low levels of ESP (5), whereas the hydraulic conductivity (HC) of these soils was less sensitive. The presence of lime in the soils was effective in preventing HC decreases due to low levels of exchangeable Na. Conversely, lime was not effective in maintaining the IR of the calcareous soils. Phosphogypsum prevented the sharp drop in IR of the soils at all levels of ESP. The mechanical impact of the raindrops, the low concentration of electrolytes in the rain and in the surface soil solution, and the relative freedom for particle movement at the soil surface accounts for the higher susceptibility of the soil surface to exchangeable Na. The high rate of dissolution of phosphogypsum, leading to the presence of electrolytes in the surface soil solution, accounts for the effectiveness of phosphogypsum in maintaining the high IR. The effect of low levels of ESP and the soil solution concentration of the IR of soils suggests that crust formation in soils is due to two mechanisms: a physical dispersion of soil aggregates caused by the mechanical impact of the raindrops; and a chemical dispersion caused by the soil ESP and the low electrolyte concentration in the applied water. (Moore-IVI)
W84-01597

THE INFLUENCE OF THE INITIAL WATER CONTENT ON THE REDISTRIBUTION OF SOIL WATER AFTER INFILTRATION,
Agricultural Coll. of Athens (Greece). Lab. of Agricultural Hydraulics.
A. Poulovassilis.
Soil Science, Vol. 135, No. 5, p 275-281, May, 1983. 5 Fig, 15 Ref.

Descriptors: *Soil water, *Infiltration, *Redistribution, Wetting boundary, Drying boundary, Hysteresis loop.

The effect of the initial soil water content prevailing in a porous column before the initiation of an infiltration-redistribution cycle on the redistribution rate was studied both theoretically and experimentally. The initial water content may vary following either the drying boundary or the wetting boundary curve of the hysteresis loop involved in the infiltration-redistribution process. The redistribution rate for initial states on the drying curve is greater than that for states on the wetting boundary curve. An increase of the initial water content along the drying curve may result in an increase of the redistribution rate, though an increase along the wetting curve may result in a decrease of the redistribution rate. The development of the redistribution pressure head profiles was followed in a 55 cm long tube packed uniformly with beach sand to give a porous body characterized by the hysteretic relationships between soil water content and pressure head. The experimental results support the theoretical conclusions. (Moore-IVI)
W84-01599

THE ROLE OF AIR AND WATER RESIDUALS FOR STEAM ELECTRIC POWER GENERATION,
North Carolina Univ. at Chapel Hill. Dept. of Economics.
N.-B. Tran, and V. K. Smith.
Journal of Environmental Economics and Management, Vol. 10, No. 1, p 35-49, March, 1983. 3 Tab, 39 Ref.

Descriptors: *Water pollution control, *Steam electric powerplants, *Cost analysis, Electric power industry, Regulation, Policy, Industrial wastewater, Effluent, Economic aspects, Mathematical models.

An attempt was made to treat atmospheric and waterborne residuals as joint outputs with electricity in modeling the ex post production technology for steam generating electric power plants. Using a joint output cost function, the findings support the inclusion of these measures in the cost functions for all vintages of the power plants. They suggest that the residual outputs cannot be treated as separable from the variable inputs with any of these vintages. Measured input substitution in previous studies may not accurately reflect the features of the expost technology. These findings also have direct implications for policy concerns. The control of atmospheric and waterborne residuals will necessarily affect the optimal allocation of factor inputs. This suggests that the ex post technology for steam electric generation embodies a response pattern to environmental regulation that is similar to that of ex ante design analyses: in both cases, it can be expected that the adjustments to environmental controls will not be neutral in their effects on factor input usage. Of course, there are likely to be substantial differences between ex ante and ex post technologies in the actual nature of these effects. (Moore-IVI)
W84-01605

POLLUTION CONTROL AND INPUTS TO PRODUCTION,
Tennessee Technological Univ., Cookeville. Dept. of Management, Marketing and Economics.
K. W. Ketkar.
Journal of Environmental Economics and Management, Vol. 10, No. 1, p 50-59, March, 1983. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Water pollution control, *Industrial wastwater, *Cost analysis, Labor, Capital, Chemical industry, Electrical industry, Oil industry.

The inputs required for air, water, and solid waste pollution abatement in the United States are identified. Industry level data on pollution abatement expenditures in 1976 are broken down into expenditures on various intermediate inputs and on two primary inputs - labor and capital. The 1971 input-output table is adjusted to reflect the input needs of pollution abatement technology. This revised direct input coefficients matrix is used to derive the gross output and primary input requirements of the 1971 final bill of goods. Pollution abatement technology requires inputs from some industries such as chemicals, electricity, and petroleum products, which are highly polluting. This implies that in the process of abating pollution, more pollution will be generated. By using the adjusted input-output matrix, the effect of current (operating) pollution abatement expenditures on the gross outputs of polluting industries, industries supplying inputs for pollution abatements, and other industries are determined. Directly and indirectly roughly 124,000 new jobs would be created per 1 billion dollars of direct pollution abatement expenditure. (Moore-IVI)
W84-01606

OPTIMAL INVESTMENT TO REDUCE THE DECAY RATE OF AN INCOME STREAM: THE CASE OF SOIL CONSERVATION,
California Univ., Davis. Dept. of Agricult Economics.
R. A. Collins, and J. C. Headley.
Journal of Environmental Economics and Man ment, Vol. 10, No. 1, p 60-71, March, 1983. 4 4 Tab, 11 Ref.

Descriptors: *Soil conservation, *Investm *Farming, Soil management, Erosion, Costs, S dies, Capital, Iowa.

Some natural resource investments are unique f a capital theory point of view because they do create a new income stream, but rather alter rate of change of an existing stream of incom social benefit. A firm level model is presented choice of optimal expenditures for soil conse tion capital. The model suggests that the opti decay rate of income due to soil loss depend current farm income, the interest rate, and the effectiveness of soil conservation capital. I from southern Iowa were used to demonstrate farmers in the same area may rationally beh differently when faced with a government sub program for conservation. The model gives a b for calculating the private internal benefits of conservation capital and, therefore, a basis for dicting behavior. (Moore-IVI)
W84-01607

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

RESERVOIR MANAGEMENT: A RELIA ITY PROGRAMMING APPROACH,
California Univ., Davis. Dept. of Land, Air Water Resources.
For primary bibliographic entry see Field 4A.
W84-01703

6B. Evaluation Process

ALTERNATIVE POLICY INSTRUME UNDER UNCERTAINTY: A PROGRAMM MODEL OF TOXIC POLLUTION CONTR
Meta Systems, Inc., Cambridge, MA.
For primary bibliographic entry see Field
W84-01609

WATER RESOURCE AND THE ENVIR MENT: DEVELOPMENT PLANNING BRAZIL,
Brazilian National Committee on Large Dams, Paulo.
For primary bibliographic entry see Field
W84-01629

USE OF THE METHOD OF MULTIPURP OPTIMIZATION FOR ECONOMIC JUST CATION OF HYDROPOWER INSTAL TIONS,
V. R. Okorokiv, and D. S. Shchavelev.
Hydrotechnical Construction, Vol. 16, No. 571-575, October, 1982. Translated from Gi tekhnicheskoe Stroitel'stvo, No. 10, p 32-34, O ber, 1982.

Descriptors: *Economic justification, *Dam struction, *Mathematical studies, Water man ment, Water resources development, Powerpl Systems analysis.

The systems approach is frequently used w justifying the construction of hydropower inst tions. In this approach the hydropower stati regarded as a component of electric power water management systems. The systems appro consists in combined consideration of all nat economic consequences due to internal and e nal, direct and inverse relations of these syst Methods and models of solving optimization p lems in power engineering and water manage use the minimum of adjusted expenditures as

on. This method is based on a bottom-level
ion of the properties of the systems. The
l of adjusted expenditures makes it possible
rmine the comparative effectiveness of com-
variants on the basis of analyzing the input
eristics-capital investments and annual out-
justed to the same dimension by means of
ndard cost-effectiveness ratio. The multipur-
ptimization method is more general than the
l of minimum adjusted expenditures. If all
itures needed for attaining several purposes
expressed in terms of adjusted expenditures
e social consequences of realization of all
s are practically the same, then the same
will be the most effective both by the
rpose optimization method and by the
of minimum adjusted expenditures. (Baker-

741

Water Demand

**ATION OF WATER DEMANDS USING
T ANALYSIS,**
mental Protection Agency, Cincinnati,
inking Water Research Div.
lark, J. A. Goodrich, and J. I. Gillean.
of Water Resources Planning and Manage-
ol. 109, No. 4, p 271-286, October, 1983. 8
ab, 12 Ref.

tors: *Water demand, *Water resources de-
nt, Reservoir sizing, Streamflow, Deficit
River basin development.

ition for water among governmental enti-
h common river systems has become in-
ly fierce. This competition will no doubt
even more fierce as populations continue
and become increasingly dispersed. One of
or issues involved in water resource avail-
the construction of reservoirs to provide
us and dependable water supply. Histori-
e approach to reservoir 'sizing' is based on
ng the lowest historical system flow
the highest water demands anticipated.
ecently stochastic techniques have been
estimate water yield. This paper uses a
e, 'deficit analysis,' that matches available
rsus actual and/or projected demands. If
exceeds available flow, a deficit occurs
st be satisfied by flow augmentation or
capacity. Standard techniques such as the
rocedure or routing techniques can reveal
ounts of water required. By studying the
d timing of deficits important additional
formation can be gained. The technique is
n a case study context to reservoir selec-
he Washington D.C. Metropolitan Area.
s abstract)
65

**IA'S WATER STRATEGY: BRING
N AND RESTRICT ITS USE,**
son.
gineering, Vol. 53, No. 4, p 46-49, April,
ig.

ors: *Water demand, *Water supply de-
nt, *Groundwater management, *Legisla-
ter supply, Regulations, Water manage-
sidence, Arizona.

evices suddenly appeared in the Arizona
r Phoenix and Tucson in the fall of 1982
ecades of pumping groundwater out at a
greater than the natural rate of replenish-
e major use of this water was agriculture
es 89% of all the water consumed in the
e state's 1980 Groundwater Management
ides for a state-managed reduction in the
e of available water to be used by agri-
The Act is the first in any state to limit the
of groundwater. The Act sets manage-
ls for the biggest problem areas of the
enix, Tucson, and Prescott metropolitan
the primarily agricultural areas of Pinal
The goal for the cities is safe yield, which
as the maintenance of a balance between
ater withdrawals and groundwater re-

charges by January 2025. After 2005, using powers granted by the Act, the state will buy up and retire farmland as needed to restore water balance. To restore and achieve the eventual balance of water supply and demand, agricultural usage will have to be reduced to between 65 and 70%. A groundwater withdrawal fee or pump tax will be imposed to help defray costs of the program. Another important and controversial provision of the law is one which will effectively discourage real estate development in areas of the state where ground water supply is inadequate. (Baker-IVI)
W84-01479

MANAGING RAFTING RIVERS,
Abt Associates, Inc., Cambridge, MA.
D. Berry, C. Cox, and P. Wolff.
Water Spectrum, Vol. 15, No. 1, p 10-17, Spring, 1983. 5 Fig, 2 Tab.

Descriptors: *Recreation demand, *Water use, *Water management, *Rafting, Wilderness, Recreation facilities, Environmental effects, Aesthetics.

In the northeast, conflicts are now arising from large-scale rafting and these are beginning to face recreation and natural resource agencies. This is especially true considering the prevalence of rafting on scenic rivers in primitive woodland environments. Management considerations fall roughly into five categories: launch and take-out characteristics which determine the number of launches which can effectively be handled by a site in a given period of time; launching hours, determining the number of launches which can be made in a given day; number of raftable days, determined by numbers of weekend days and holidays which fall during the rafting season; lunch or break site factors, which are determined by the number of launches being made from one point during the day; and conflicts with other activities such as anglers, canoeists, campers, and with traffic on the roads near the river. Management strategies call for the adoption of a river recreation management plant, the application of land use controls along the river, the imposition of use limits, the requirement of obtain access or other permits, the certification of guides and imposition of safety requirements, and the control of river flow. In order to manage effectively, those responsible for management must have a solid data base documenting point of congestion, environmental damage, conflicts with other recreation activities, and detraction from the aesthetic aspects of rafting by crowding. (Baker-IVI)
W84-01639

CAPACITY EXPANSION MODEL FOR LARGE-SCALE WATER-ENERGY SYSTEMS,
International Engineering Co., Inc., San Francisco, CA.
J. Matsumoto, and L. W. Mays.
Water Resources Research, Vol. 19, No. 3, p 593-607, June, 1983. 13 Fig, 11 Tab, 9 Ref.

Descriptors: *Energy, *Water resources development, *Mathematical models, *Resources development, Computer models, Water demand, Capacity, Optimization.

Development of new energy facilities can be constrained by the availability of raw energy and water resources as well as the location of major demand centers for these resources. A mathematical optimization model has been developed to help investigate alternatives for the capacity expansion of water-energy systems. The system consists of four subsystems: water, coal, electricity, and gas systems. Expressing new capacities, production, and distribution activities mathematically, the mathematical structure of the problem is defined and formulated as a multisystem, multiperiod capacity expansion problem. A major emphasis in development of this model was to handle very large scale systems. Benders decomposition is applied to the original problem to decompose it into three problems: capacity, production, and distribution problems. Each problem is solved by specialized algorithms. An example problem was solved. The computer code, CAPX1, for the capacity expansion of water-energy systems consists of approximately 7000 Fortran statements. The code is dimensioned to handle a water-energy system of 240 new projects, 50 existing facilities, 3 time periods, and for each subsystem, 400 nodes and 1000 arcs. (Moore-IVI)
W84-01701

6E. Water Law and Institutions

LAND APPLICATIONS OF WASTEWATER: WATER RIGHTS ISSUES,
Western States Water Council, Salt Lake City, UT.
C. Bell, W. E. Cox, and G. Fiedler.
Journal of Water Resources Planning and Management, Vol. 109, No. 4, p 287-302, October, 1983. 25 Ref.

Descriptors: *Land disposal, *Water rights, *Wastewater disposal, Legal aspects, Water use, Return flow, Appropriation, Riparian rights, Municipal wastewater, Effluents.

Land application of municipal effluents is encouraged by existing federal water quality legislation and regulations as an alternative to conventional surface water discharge of partially treated effluent. However, conversion to the land application approach may impact downstream water users since the associated operations are likely to increase water consumption or change the location of return flows, or both. The legal status of such changes must be evaluated by application of state water law. In the western United States, the doctrine of prior appropriation protects appropriators whose water rights depend on return flows of prior appropriators by restricting changes in the manner in which the prior rights are exercised. In the East, the riparian doctrine sets limits on the amount of water consumption and place of water use. Although there is little direct precedent interpreting the principles of the two doctrines in relation to land application, potential constraints exist. This paper evaluates the significance of these constraints and the possible impact of water law on the adoption of the land application technique. (Author's abstract)
W84-01466

SOIL EROSION: ECONOMIC AND TECHNOLOGICAL INTERFACES,
Department of Agriculture, Washington, DC.
For primary bibliographic entry see Field 4D.
W84-01611

TRANSFERABLE DISCHARGE PERMIT TRADING UNDER VARYING STREAM CONDITIONS: A SIMULATION OF MULTIPERIOD PERMIT MARKET PERFORMANCE ON THE FOX RIVER, WISCONSIN,
Colby Coll., Waterville, ME. Dept. of Economics.
W. B. O'Neil.
Water Resources Research, Vol. 19, No. 3, p 608-612, June, 1983. 5 Tab, 4 Ref.

Descriptors: *Permits, *Water pollution control, Legislation, Model studies, Water quality, Cost analysis, Water temperature, Flow, Regulation, Wisconsin, Fox River.

The state of Wisconsin has recently established the legislative basis for what may be the first, operating water-pollution permit market in the United States. A multiperiod water quality planning model is developed to illustrate the performance of a TDP market under conditions of varying stream flow and temperature. The model is applied to the case of the Fox River and is used to compare the cost of achieving target water quality levels under conventional regulatory rules with the cost associated with operation of a TDP market. In addition to the cost estimates, the simulation of market performance yields information on the probable pattern of trading that may occur in the Fox River TDP market. The traditional rules for abatement allocation were about 40% more costly than the minimum-cost potential market solution. Under the worst case flow-temperature scenario the analysis showed that up to $7 million could be spent annu-

ally on the management of a market before the market would be a less-preferred strategy. The market could exhibit inefficiencies as a result of a lack of information or imperfect competition that would reduce the cost differential until a $6 million difference vanished. The empirical analysis of the Fox River provides strong support for further consideration of the permit market idea. (Moore-IVI)
W84-01702

6F. Nonstructural Alternatives

WATER SUPPLY,
D. P. Sheer.
Civil Engineering, Vol. 53, No. 6, p 50-53, June, 1983. 2 Fig.

Descriptors: *Water supply management, *Water supply development, Water demand, Water supply, Washington, D.C., Virginia, Maryland, Design criteria, Water management.

Cooperative water supply agreements for the Washington, D.C. metropolitan area, based on state-of-the-art water resources management techniques, have ended a 30 year search for solutions to the region's recurring water shortages. Implementing these innovative operating procedures required eight separate agreements among agencys including the US Army Corps of Engineers, the states of Maryland and Virginia, the District of Columbia, two local utilities, and the Interstate Commission on the Potomac River Basin. The agreements are based primarily on almost costless, cooperative, improved operations of existing facilities, using state of the art flow and daily demand forecasting techniques. Construction of one small local reservoir, $30 million, is included, but that is not so much needed for the quantity of water it will hold as for the additional operational flexibility it provides. Overall system yield has been increased by nearly 50% and individual project yields by as much as 200%. Engineering achievements in the system include: the combination of optimization and simulation techniques to provide practical rules for operation of the entire system: the first large scale implementation of the National Weather Service River Forecast System, the development and implementation of a technique to predict water demand and the application of that technique in water source system design and operation; the combination of distribution analysis and hydrologic modeling to develop operating procedures for a complex water distribution system; the use of risk analysis to identify the start of potential droughts and to quantify the risks of continued drought: and the use of drought games to test and improve the water supply operating procedures and to illustrate the use of those procedures to decision makers, and the use of a small local reservoir to augment the yield of upstream impoundments. (Baker-IVI)
W84-01482

IMPROVED FLOODPLAIN MANAGEMENT CAN BE COST-EFFECTIVE,
For primary bibliographic entry see Field 2E.
W84-01666

6G. Ecologic Impact Of Water Development

DISTRIBUTION OF LARVAL FISHES RELATED TO POTENTIAL NAVIGATION IMPACTS ON THE UPPER MISSISSIPPI RIVER, POOL 7,
National Fishery Research Lab., La Crosse, WI.
L. E. Holland, and J. R. Sylvester.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 293-301, March, 1983. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Navigation, *Environmental effects, *Mississippi Rivers, *Fish, Larvae, Plankton, Diel distribution, Spatial distribution, Seasonal variation, Bass, Perch, Crappie, Drum, Shad, Carp, Channels, Boats.

Ichthyoplankton samples were collected twice monthly during spring and summer 1981 from a variety of habitats in Navigation Pool 7 of the upper Mississippi River. Larval-fish distributions in the pool and variations in those distributions were analyzed relative to potential impacts of increased commercial navigation. Although as many as 66 species of adults have been found in the area (33 considered common), only 17 taxa were identified from the collections. In April and May, most larvae were collected in main-channel and main-channel-border areas next to major expanses of shallow backwaters. White bass Morone chrysops, yellow perch Perca flavescens, and crappies Pomoxis spp. were predominant. Numerous catostomids also were taken. In June and July, most larvae were taken in the lower pool. Freshwater drum Aplodinotus grunniens and gizzard shad Dorosoma cepedianum predominated in these samples, which also included many cyprinids and centrarchids. Diel patterns of abundance varied with species and sampling location. Freshwater drums were more abundant near the surface at midnight than during the day. Common carp Cyprinus carpio were most abundant in collections at dusk, whereas all other cyprinids were most abundant at dusk and dawn. Numbers of gizzard shad also increased slightly at dusk. Total numbers of larvae collected were greatest at dusk in main-channel and main-channel-border samples; backwater areas produced the greatest catches at midnight and dawn. Seasonal, spatial, diel, and species-specific variations in larval fish abundances significantly influenced the proportion of the community potentially vulnerable to increased boat traffic through Pool 7. (Author's abstract)
W84-01408

HABITAT SELECTION IN THREE SPECIES OF DARTERS,
Saint Louis Univ., MO. Dept. of Biology.
F.H. McCormick, and N. Aspinwall.
Environmental Biology and Fishing, Vol. 8, No. 3/4, p 279-282, 1983. 3 Tab, 16 Ref.

Descriptors: *Fish, *Habitats, *Behavior, *Distribution, Vegetation, Etheostoma, Meramec River, Missouri, Percidae, Substrates.

The distribution of three species of darters (Percidae) was studied with respect to vegetation and substrate preferences. The three species were greenside darter, Missouri saddled darter, and banded darter. The study was made in the Meramec River drainage, Missouri. Based on pooled field data from five collecting sites, Etheostoma blennioides and E. zonale showed a highly significant distribution with respect to vegetation. E. tetrazonum, in contrast, was associated with substrate and Etheostoma blennioides and E. zonale demonstrated a significant preference for vegetation in olfactory gradient choice chamber experiments. In preference tests in the artificial stream, E. blennioides and E. zonale showed preference for natural vegetation versus substrate. In trials where the fish were presented with alternating patches of natural and artificial vegetation, post hoc comparisons revealed a significant preference for natural vegetation over artificial vegetation and substrate. (Baker-IVI)
W84-01448

MODELING OF UNSTEADY-FLOW WATER TEMPERATURES,
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W84-01540

REVERSING THE FLOW OF SOVIET RIVERS.
For primary bibliographic entry see Field 3B.
W84-01622

THE TUCURUI EXPERIENCE,
Centre International de Recherches sur l'Environnement et le Developpement, Paris (France).
E. Monosowski.
International Water Power and Dam Construction, Vol. 35, No. 7, p 11-14, July, 1983. 2 Fig, 7 Ref.

Descriptors: *Dam construction, *Reser
Brazil, Tucurui Reservoir, Powerplants, Wat
sources development, Environmental effects.

The largest man-made lake in Brazil, and the
est to be constructed in a tropical rainfor
scheduled to be filled next year. Tucurui d
located 300 km south of Belem, the main c
the Eastern Amazon, and the dam will cre
2160 sq km reservoir, flooding the forest and
ing up water for 200 km along the Tocantins
The accumulation of 4,300,000 cu m of wate
generate 2115 MW in the first stage, and the
installed capacity will be 800 MW. While th
curui scheme will be beneficial for the econ
development of the whole Amazon area, its
ronmental impacts could endanger the very
ence of the project. The Amazonian ecosy
are very complex, diverse and almost unkn
Decomposition of an enormous volume of ve
tion in the flooded area will impair the
quality, thereby reducing oxygen availability
affecting aquatic organisms. The retention
the depth and the temperature of the water a
speed of circulation appear to favor oxygenati
Tucurui allowing a rapid aerobic decompositi
most of the forest. While some flora and faun
be destroyed, the dendritic-reticulate configur
of the reservoir will be an ideal habitat for w
weeds, with the accompanying problems.
dams will have an improving effect on the q
of life in distant communities, the lives of tho
the immediate area will not likely be impr
(Baker-IVI)
W84-01627

THE STORM OVER SILENT VALLEY.
International Water Power and Dam Construc
Vol. 35, No. 7, p 14-17, July, 1983. 3 Fig.

Descriptors: *Environmental effects, *Wate
sources development, Decision making, Dam
struction, Powerplants, India, Silent Valley, K
State.

Silent Valley is a small and until recently unk
strip of dense forest in Kerala state, at the s
ernmost tip of India. The valley occupies 89
of what may be loosely described as tropical
forest. It lies on a plateau perched on the we
ghats, a range of mountains which border
1000 mile long coast of peninsular India. The
has an average annual rainfall of 4600 mm o
catchment of 77 sp km and the Kunthi is exp
to yield an annual run-off of 293,000,000 cu m.
river offers a straight head of 857 m, the high
Kerala. Silent Valley project envisages the
struction of a rolled concrete arch dam, 131 m
and 430 m long; the creation of a reservoir
merging 830 ha and impounding 317,000,000
of water; a water conductor system comprisi
4267 m long power tunnel, 260 m long pre
pipeline and a 2355 m long penstock branc
into two near the powerhouse; and a power st
on a small stream joining the Kunthi at the fo
the hills, 8 km from Mannarghat. Environme
ists are urging that the project be abandoned
the area declared a Biosphere Reserve. It is th
vestige of a natural climax vegetation of
region, and species in Silent Valley may
tremendous commercial potential. If the sche
abandoned the benefits that will not be rea
include: generation of 538 GWh of energy a
expected to yield $10 million from sales of p
and an increase in the GDP of $60-$100 mi
annually; irrigation of 10,000 ha in Palghat
Malappuram districts from the tailwaters; an
development of the most backward region o
state - the northern region of Malabar, where
project is to be situated. (Baker-IVI)
W84-01628

**WATER RESOURCE AND THE ENVIR
MENT: DEVELOPMENT PLANNING
BRAZIL,**
Brazilian National Committee on Large Dams,
Paulo.
F. M. G. Budweg.

ational Water Power and Dam Construction, 35, No. 7, p 23-24, 29-30, July, 1983. 1 Fig, 4

iptors: *Dam construction, *Planning, *Environmental effects, Decision making, Water re- s development, Powerplants, Brazil.

ng procedures are being devised in Brazil im at the optimization of the multipurpose dams and reservoirs and the conservation of nvironment. More than 90% of the electrical consumed throughout the country is hywer. After World War II the country experian initially modest, but quickly progressing pment of industrial activities. Parallel with it an upswing in agricultural production that d the spread of farming westwards into the y's interior. New hydroplants with ever dams and reservoirs began to be constructed ons further away from consumption centers. l hundred dams for water storage and irrigave been built in the semi-arid northeast since the turn of the century. Major efforts ng concentrated on flow regulation projects ill serve the double purpose of avoiding by the large-scale storage of excess runoff e transformation of intermittent into pereners by the controlled release of stored water gation of large tracts of new farmland. Planow revolves around multiple purpose projeservoirs should be built after determining st possible use of the water body created, ducing the number of specific projects to a m and obtaining the maximum advantage ach of them; and secondly, the reservoir hould cover the mitigation of the unavoidpacts on the natural and social environment. ted reservoir development results in many n the need for some immediate expenditure tion to that which would be incurred if the were devised for its original purpose only. er, in the long run integrated reservoir deent is undoubtedly the most economical . (Baker-IVI)
629

CT STUDIES FOR DAMS AND RESER-

ma Univ., Norman.
Canter.
tional Water Power and Dam Construction, , No. 7, p 18-23, July, 1983. 1 Fig, 3 Tab.

tors: *Environmental effects, *Dam con- n, *Reservoirs, *Planning, Water quality, resources development, Environmental statement, Regulations.

ction and operation of large dams and hytric projects can cause significant environimpacts. Systematic environmental impact are needed to predict and assess these imd identify appropriate mitigation measures. predictions can be made using a qualitative h which relies on general knowledge of the of similar projects, or specific results of hensive studies of similar projects or on a tive approach based on the use of math- models for multiple environmental facgiven environmental impact study will y involve all these approaches. Impact ast includes the use of water quality standd criteria, appropriate laws and regulations to the biological environment, and profesknowledge and judgement. Systematic are also available for comparing alterna- r large dams and hydroelectric projects. ent or interpretation of predicted impacts ts a vital activity in an environmental study. Decisions based on this activity inwhether or not to approve a proposed and whether or not to prepare an environimpact statement. Additionally the study ntify ways in which impacts can be mitigatdecide if these measures are necessary. mental impact studies typically consider a n of two options, but can include a study more. The minimum number is a choice construction and operation of a project oject non-approval. As more possible are included it becomes more and more necessary for a systematic environmental impact study to incorporate methodologies for trade-off analyses and decision-making between different choices. (Baker-IVI)
W84-01630

DEGRADATION OF THE RIVER NILE,
Research Inst. of Saad El Aali Side Effects, Cairo (Egypt).
S. Shalash.
International Water Power and Dam Construction, Vol. 35, No. 7, p 37-43, July, 1983. 7 Fig, 11 Tab.

Descriptors: *Environmental effects, *Water resources development, *Dam construction, Egypt, High Aswan Dam, Nile River, River beds, Sedimentation, Reservoirs.

One of the major tasks of the Research Institute of Saad El Aali Side Effects is to monitor the annual effects of degradation on the Nile River channel, particularly downstream of the existing hydraulic structures, occurring as a result of the construction of the High Aswan Dam in Egypt. The reach of the river currently under study starts from downstream of the low Aswan dam and ends upstream of the Delta barrage, a length of 953 km. There are five main control structures, each of which was built to a hydraulic design which did not affect the hydrological regime of the river before the construction of the High Aswan dam. Main hydrological parameters were recorded during the collecting of field data: suspended load measurements; water level records; discharge measurements and hydrographic survies. Downstream of Low Aswan, the drop in water levels varies between 42 and 40 cm for discharges of 10,000,000 cu m/day and 25,000,000 cu m/day, respectively. This is the total drop in water during the period 1964-1982. Downstream of Esna barrage the total drop in water level varies between 72 cm and 15 cm for discharges of 100,000,000 cu m/day and 200,000,000 cu m/day. For discharges of 80,000,000 cu m/day the drop in water levels was 76 cm for discharges of 80,000,000 cu m/day during the same period. Downstream of Naga Hammadi barrage the total drop in water levels is between 65 cm and 99 cm for discharges of 200,000,000 cu m/day and 800,000,000 cu m/day during the same period. Downstream of Asiut barrage the total drop in water levels are recorded as 49 cm and 78 cm for discharges of 150,000,000 cu m/day and 80,000,000 cu m/day during the same period. (Baker-IVI)
W84-01631

MALAYSIA ABANDONS TEMBELING,
Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Geography.
S. S. Rachagan.
International Water Power and Dam Construction, Vol. 35, No. 7, p 43-47, July, 1983. 3 Fig, 6 Ref.

Descriptors: *Dam construction, *Environmental effects, *Water resources development, Planning, Reservoirs, Tembeling, Powerplants, Malaysia, Taman Negara, Public opinion.

A proposal to build a dam in Taman Negara for the Tembeling hydroelectric project was first brought forward in October 1971. The Sungai Tembeling is an upper tributary of Peninsula Malaysia's longest river, the Sungai Pahang. The need for flood mitigation and the hydroelectric power potential of the basin were the principal considerations for the dam. The project would have consisted of a main dam, saddle dams and associated works, including an intake feeding through a power tunnel to a conventional surface power station. With a total installed capacity of 110 MW comprising four units of 27.5 MW each, the average annual output of energy would be 441 GWh. A gated shaft spillway was planned with a capacity of 4800 cu m/sec for regulating flood discharges. Ecologists argued that flooding of such a large area could not be undertaken without societal consensus as to whether a large dam in this specific area was needed and sound as part of the nation's energy scheme. The key issue was that this area which had been proposed for the development of the dam and support structures was located in Malaysia's first and largest national park, a matter of great importance to the public. After 12 years of talking, researching, and considering alternatives, it appears that the environmentalists have convinced the Malaysian government of the need to abandon the proposed project. (Baker-IVI)
W84-01632

DEGRADATION OF THE RIVER NILE,
Research Inst. of Saad El Aali Side Effects, Cairo (Egypt).
S. Shalash.
International Water Power and Dam Construction, Vol. 35, No. 8, p 56-58, August, 1983. 7 Fig, 2 Tab.

Descriptors: *Environmental effects, *Dam construction, *Water resources development, Dams, Nile River, Egypt, High Aswan Dam, Deltas, Water levels, Discharges.

In order to monitor in the future the annual rate of change in the surface water slope of the Nile, the following methods were adopted to ensure good basic data for comparison. Water level gauges were selected at the beginning and end of reaches affected by degradation downstream of the hydraulic structures. Mean annual discharges downstream of each barrage, and water levels for the period 1963-1982 were measured. A relationship between the mean discharges and mean slopes for each reach are shown for the period 1963-1980. To calculate the slopes which correspond to the discharges before construction of the Aswan High dam, the same method was used. From the change in surface water slopes during the period 1963-1982, the maximum drop downstream of each structure was as follows: Low Aswan dam = 89 cm; Esna barrage = 65 cm; N. Hammadi barrage = 104 cm; and Asiut barrage = 96 cm. Eighteen years have elapsed since the High Aswan dam began to have an effect on the hydrological regime of the river Nile. The findings suggest a large difference between some of the theoretical forecasting and the actual results as regards the rate, maximum magnitude and time taken for the complete degradation process. (Baker-IVI)
W84-01638

THE JONGLEI CANAL: A DITCH TOO BIG,
R. Eshman.
Environment, Vol. 25, No. 5, p 15-20, June, 1983. 4 Fig, 40 Ref.

Descriptors: *Water resources development *Environmental effects, *Canals, Jonglei Canal, Egypt, Sudan, Nile, Drainage, Swamps, Hydrology.

The Jonglei Canal will run from Bor to Malakal in the southeastern district of Jonglei, Sudan when completed. It is not known how diverting water from the swamp ecosystem will affect the land, the indigenous people, and the hundreds of species of exotic wildlife in the Sudd. The purpose of the canal is to allow Egypt and Sudan to place 400,000 acres under irrigated cultivation and 4 million more when the canal is enlarged as planned. A total of 4.7 billion cu m of water will be diverted each year from the Sudd to irrigation projects downstream. The canal will also provide a time-saving transportation route from north to south. To achieve these ends no more than 19% of the Sudd will be drained. Critics of the canal foresee a possible breakdown in swamp ecology leading to up to 100% loss of these vital lands. A mathematical study has been made of the Nile hydrology. The Sudd's water table is replenished through the adsorption of water overspilling the river banks of the Nile in flood season. Reducing the amount of this overspill, which the Jonglei certainly would do, would affect the water table, possibly lowering it to such a degree as to affect the lives and environment of people far removed from the actual canal. A model was completed which assesses the amounts of inflow, outflow, seepage, and evaporation in the Nile region. (Baker-IVI)
W84-01727

SCHISTOSOMIASIS AND WATER PROJECTS: BREAKING THE LINK,
J. B. Tucker.

Environment, Vol. 25, No. 7, p 17-20, September, 1983. 2 Fig, 15 Ref.

Descriptors: *Human diseases, *Parasites, *Water resources development, *Environmental effects, *Schistosomiasis, Pathology, Diseases, Public health, Irrigation, Vectors, Drainage, Water management.

Schistosomiasis, after malaria, is now the world's most widespread, serious infectious disease. Many water resource development projects in tropical areas have had the unintended consequence of markedly increasing the prevalence of schistosomiasis in the local population. Water contact is the most critical variable in the transmission of schistosomiasis. Irrigation of formerly arid regions creates additional habitats for the snail vectors beyond those already present in ponds in rivers. Defects in the design or engineering of water projects may also provide new habitats for the snail hosts. The water projects have provided new opportunities for villagers to come into contact with the infested water, particularly when the projects are located close to villages in which no alternative water sources are available. The advent of perennial irrigation, in which the irrigation canals are is use year-round, has facilitated the multiplication of the snail vectors of schistosomiasis. Perennial irrigation has removed natural checks on the snail population enabling them to multiply out of control. Once snails have been introduced into an irrigation system it is impossible to eradicate them completely. If irrigation projects are supplied with efficient drainage, good water management and regular maintenance, it is possible to avoid an increase in the incidence of schistosomiasis. (Baker-IVI)
W84-01728

7. RESOURCES DATA

7B. Data Acquisition

COMPARISON OF TWO ICHTHYOPLANKTON SAMPLING GEARS WITH NOTES ON MICRODISTRIBUTION OF FISH LARVAE IN A LARGE RIVER,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
R. P. Gallagher, and J. V. Conner.
Transactions of the American Fisheries Society, Vol. 112, No. 2B, p 280-285, March, 1983. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Fish, *Plankton, *Sampling, Biological samples, Larvae, Shad, Drum, Spatial distribution, Mississippi River.

A pilot comparison of two ichthyoplankton sampling gears was conducted in the lower Mississippi River, Louisiana. The two gears were (1) a 1-m-diameter conical plankton net towed at the surface and (2) two 0.5-m-diameter, bridleless, conical nets pushed at the surface from either side of the bow of a boat. Sampling was conducted on two different days, during light and dark periods, at three stations representing swift surface currents, sluggish currents, and slack water. Ichthyoplankton were more abundant in townet collections at the fastwater station during daylight hours and at the slackwater station at night, whereas pushed nets were more effective at the slackwater station during daylight hours and at the fastwater station at night. Shads Dorosoma spp. and freshwater drum Aplodinotus grunniens accounted for 94% of all fish larvae collected. Relative abundance of shads was greatest in daylight pushnet collections whereas drum were most abundant in daylight townet collections. Major additional trends: (1) shads, particularly protolarvae, were concentrated in the upper 50 cm of the water column in daylight collections, but were more uniformly distributed at night; (2) freshwater drums were more abundant in the 50-100-cm stratum during daylight collections, but were more uniformly distributed at night; (3) older freshwater drum larvae were more abundant in nighttime collections, whereas protolarvae were more abundant in daylight samples. (Author's abstract)
W84-01406

A SIMPLE TOXICITY APPARATUS FOR CONTINUOUS FLOW WITH SMALL VOLUMES: DEMONSTRATION WITH MYSIDS AND NAPHTHALENE,
Lehigh Univ., Bethlehem, PA. Dept. of Biology.
R. L. Smith, and B. R. Hargreaves.
Bulletin of Environmental Contamination and Toxicology, Vol. 30, No. 1, p 406-412, April, 1983. 2 Fig, 20 Ref.

Descriptors: *Continuous flow, *Toxicity, *Invertebrates, Measuring instruments, Naphthalene, Mysids, Crustaceans.

To determine the toxicity of naphthalene to the mysid crustacean Neomysis americana, a small continuous flow toxicant exposure system using design features of Mariotte bottle chemostats was built. The Mariotte bottles were modified by the addition of air inlet restrictors, providing a stable flow at low pressure heads. Solutions of naphthalene in artificial seawater were prepared with 0.5% naphthalene in 80% ethanol and placed in one-liter bottles. Rate of naphthalene loss from the reservoirs was determined by continuously measuring naphthalene concentration from a reservoir for 77 hr. Flow remained constant within 1.3% for 53 hrs regardless of volume remaining in the reservoir. There was a slight tendency for newly introduced water to stratify at the bottom of the chamber. Naphthalene disappearance probably resulted from evaporation into the reservoir head space, which could be reduced in the future by passing intake air through a bottle containing naphthalene test solution before introducing it into the reservoir. Estimated continuous-flow 96 LC50s were 1280 micrograms/liter at 15 C and 850 micrograms/liter at 25 C. Naphthalene-induced mortality was significantly greater at 25 C than at 15 C for both concentrations. Low flow allowed use of artificial seawater in small amounts, making it possible to perform tests at an inland location with standard dilution water. (Baker-IVI)
W84-01424

DATA AUTOMATION FOR WATER SUPPLY MANAGEMENT,
Idaho Dept. of Water Resources, Boise.
R. J. Sutter, R. D. Carlson, and D. Lute.
Journal of Water Resources Planning and Management, Vol. 109, No. 3, p 237-252, July, 1983. 6 Fig, 7 Tab.

Descriptors: *Automation, *Water management, *Computers, *Reservoir management, Data acquisition, Data transmission, Data processing, Streamflow, Water storage, Water allocation, Water rights, Water conservation, Snake River, Idaho.

The available daily water supply of multi-reservoir river system, the Upper Snake River in Idaho, is managed more efficiently using an automated system of data collection, transmission, and processing. Streamflow, reservoir, and canal data are transmitted daily from remote gage sites and regional terminals to a central computer where a FORTRAN program computes natural (unregulated) flow and accounts for storage water supplies. Natural flow is distributed among various uses (primarily irrigation) and users based on established water rights. Storage allocations are monitored daily to better manage remaining supplies. Daily uses and resulting supplies are projected ahead by as much as one week to reduce river operation response times. The improved management correctly accounts for water distribution by rights and for storage allocations while promoting conservation of water supplies. (Author's abstract)
W84-01464

FLOCCULATION TEST METHODS,
University Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W84-01570

AN IN SITU SEDIMENT OXYGEN DEMAND SAMPLER,
Institute of Paper Chemistry, Appleton, WI.
B. E. Markert, M. G. Tesmer, and P. E. Parker.
Water Resources, Vol. 17, No. 6, p 603-605, 1983. 3 Fig, 9 Ref.

Descriptors: *Water analysis, *Sampling, *O demand, Sedimentation, Measuring instrur Water sampling.

An SOD (sediment oxygen demand) samp illustrated which has a flow-through chambe a pyramid top. The chamber is constructed o cm clear Plexiglas material. It entraps 28.5 lit water above 0.09 sq m of sediment, with a vo to area ratio of 0.3821 m. The second comp of the sampler is the headbox unit, located boat and connected to the chamber by clear T tubing. The design of the unit provides an mechanism for controlling the major factors influence oxygen uptake by sediments. oxygen concentrations can be increased by pu air into the system, sediment disturbance c observed visually, and water is circulated diffuser through the sampler to assimilate a or lotic environment. In addition, toxicants c injected to suppress biological activity and samples can be removed during the run. (E IVI)
W84-01675

8. ENGINEERING WORKS

8A. Structures

TECHNIQUE FOR CALIBRATING NETW MODELS,
Army Engineer Waterways Experiment St Vicksburg, MS.
T. M. Walski.
Journal of Water Resources Planning and Ma ment, Vol. 109, No. 4, p 360-372, October, 19 Fig, 4 Tab, 5 Ref.

Descriptors: *Water distribution, *Mathem models, *Pipe roughness, Water use, Flow, V pressure, Fire flow tests.

In calibrating a water distribution system m the model user usually adjusts pipe roughness Hazen-Williams C factor) or water use so pressures and flows predicted by the model with values observed in the field. This paper sents formulas to assist the user in deciding w er to adjust C or water use and by how much key to using the formulas is to observe pressu the system for at least two significantly diff use rates. Such data are often collected durin flow tests. A model is considered calibrated t extent that it can predict the behavior of the distribution system over a wide range of oper conditions and water use. (Author's abstract)
W84-01471

EXPERIMENTS TO ASSESS THE HYDRAU EFFICIENCY OF WELL SCREENS,
Water Research Centre, Marlow (England).
L. Clark, and P. A. Turner.
Ground Water, Vol. 21, No. 3, p 270-281, June, 1983. 13 Fig, 6 Tab, 15 Ref.

Descriptors: *Well screens, *Hydraulic prope Head loss, Hydraulic efficiency, Gravel aqu Intake velocity.

The hydraulic properties of commercial screens were investigated to determine w screen design features affected head loss. The program began with laboratory experiments continued as a field-scale experiment with th stallation of a well field in the Thames V Gravel Aquifer. The laboratory experiments cated that, for all practical purposes, the head attributable to all of the screens tested was ne ble. The experimental head loss, however, did from screen to screen, particularly at high i velocities, and the screens could be ranked o basis of their hydraulic efficiencies. This effici hierarchy is explained tentatively in terms o screen construction methods and slot geom The field experiments showed that the hydr performance of all well screens is independe

n design provided that the open area of the n is above about 10%. The field experiments indicated that the development capacity of a n in a gravel aquifer is not wholly dependent reen design, but that progressive development increase the hydraulic efficiency of a well. hor's abstract)
-01547

GE CAPACITY BULB UNITS IN JAPAN,
Electric Co. Ltd., Kawasaki (Japan). Hydro r Div.
eda.
national Water Power and Dam Construction, 35, No. 3, p 19-24, March, 1983. 10 Fig, 2 2 Ref.

riptors: *Turbines, *Hydroelectric plants, power station, Japan, Generators, Sakuma r station, Bulb turbines, Shingo power sta-Agano River, Low head.

rch into the economical development of hydroplants has been carried out in Japan in s to increase the hydropower of that country. e major factors were considered: high effi-y; minimum civil cost; and easy maintenance igh reliability. The Akao power station is a l case in which an uneconomical low-head ecame economically feasible through new ology. Its dam impounds 600,000 cu m net e and was constructed on the Sho river to t the remaining 18 m effective head between xisting power stations at Narude and Ohara. lanned capacity was 32.5 MW, and a bulb e was chosen to give a low construction cost o fit into a narrow powerhouse which was icted by geographical limitations. The na 2 station was constructed to exploit a 15.5 d which had been left unused between the g Sakuma station (350 MW) and Akiba 2 n (34.9 MW). All the water discharged from iginal Sakuma station is led to the opposite f the Tenryu river through a reverse siphon-vater passage under the river to the headrace e newly constructed Sakuma 2 station, gh discharged to the Akiba regulating dam gh a tunnel approximately 3.2 km long and n in diameter. In still another location the o 2 station was constructed at the opposite and in parallel with the existing Shingo sta-n the Agano River, which is one of the t hydropower generating rivers in Japan. o 2 was constructed to use the whole water and to balance the available water at each . Using the existing dam of Shingo station, o. 2 station was constructed with a maximum ty of 38.8 MW at a maximum discharge of m/s and maximum net head of 22.45 m. In es the technology of bulb turbines and gener-was employed. It is assumed that in the future it capacity of bulb turbines and generators e increased to 80 MW, with heads up to 25 m gh further technological development. -IVI)
01613

TRUCTING THE DRAKENSBERG PRES-TUNNELS,
de Witt.
ational Water Power and Dam Construction, 5, No. 6, p 13-22, June, 1983. 14 Fig, 1 Tab,

ptors: *Tunnel construction, *Reinforced ete, Construction, Tunnels, Concrete, Dra-rg, Pumped storage, Storage, Water supply pment.

ower conduits for the Drakensberg pumped e scheme traverse the Drakensberg escarp-ver a distance of some 5 km with an eleva-eparation of 570 m. The interbedded sand-siltstones and mudstones, comprising the and lower Beaufort series rocks of the o system in which the scheme has been con-d, exhibit very low primary and secondary abilities. Therefore, watertight linings were equired and unreinforced concrete linings provided over much of the length of the low re conduits. Considerations related to hydro-fracture of rocks, however, required a reappraisal of this approach in the high pressure waterways. Areal jacking, or uplift of the rock strata due to excess water pressure in zones of relatively low overburden stress, could not be tolerated, and the high pressure conduits through these areas were therefore provided with watertight steel linings. The final locations of the ends of the steel linings and the design of the associated cutoff arrangements were influenced by the proximity of faults. The design of the pressure tunnel linings in areas of adequate overburden stress was dictated by considerations of the durability of the rock traversed, the severe transient pressure fluctuations expected and hydro-fracture effects in the destressed rock close to the lining. The anticipated mechanism of hydro-fracture and erosion dictated the design of the lower pressure shaft and pressure tunnel linings. Use of prestressed concrete linings, prestressed by interface grouting, ensured prevention of hydro-fracture and erosion in the pressure tunnels and lower pressure shafts by providing a watertight lining which would ensure no hydraulic connection between the rock and the waterway, and by restressing the rock, forming a composite structure and full confinement of the rock. (Baker-IVI)
W84-01623

STEEL LININGS FOR HYDRO TUNNELS,
S. Jacobsen.
International Water Power and Dam Construction, Vol. 35, No. 6, p 23-25, April, 1983. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Tunnel linings, *Water supply development, Steel, Linings, Tunnels, Tunnel construction, Water transport, Mathematical studies.

The design of a ring stiffened lining that has been recently built is discussed to demonstrate how hazardous the design of such linings can be. In the steel linings considered, the original designer used specific Amstutz formulae. While it used to be the practice to carry out prestressing of steel linings by pressure grouting in old tunnels to prevent the water from infiltrating the lining and to increase the theoretical critical external pressure, this method is unreliable. The designer therefore assumed there would be a gap between the liner and the concrete originating from the inflating effect of the internal pressure during normal operation and the inability of rock and concrete to close the gap when the tunnel is being emptied or when the internal pressure is decreased. Since the distances from the neutral axis to the extreme outside and inside elements are so different, the maximum outside and inside stresses will also be different and it may be economical to use two grades of steel. In order to prevent buckling of the shell between the ring stiffeners, the stability of the shell must always be checked against the calculation of the critical external pressure for the ring system. Since the damage of the shell is less disastrous than the buckling of the rings, it may be reasonable to use lower safety factors for the shell than for the ring stiffeners. In designing the welds connecting the stiffener rings to the pipe shell the shear force is important. It is also advisable to calculate the stresses in the welding seam between ring and shell using the moment of inertia of the ring section and the total cross sectional area of the ring (including liner); to check the combined stress at the outer side of the shell at specified points; and to calculate the hoop stresses in the lining according to a particular method. (Baker-IVI)
W84-01624

THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS OF THE LAPARAN DAM,
Bureau d'Ingenieurs-Conseils, Paris (France).
M. Hamon, P. Pouyet, and A. Carrere.
International Water Power and Dam Construction, Vol. 35, No. 8, p 19-24 and 29-30, August, 1983. 20 Fig, 15 Ref.

Descriptors: *Dam design, *Finite element method, Planning, Mathematical studies, Computers, France, Powerplants, Laparan Dam, Dams, Water resources development.

A comparison was made of the finite element analysis method specifically conceived for arch dams with the older trial load method, using the Laparan arch dam now being built in France. The thick-shell finite element analysis is a reliable and convenient tool for arch dam designers. At the design stage, in order to find the most efficient shapes for the structure, a relatively coarse mesh offers a satisfactory degree of accuracy in calculating stresses for quick and relatively cheap tests of the successive modifications made to the first conceptual design. At the subsequent stage of design justification, any desired degree of precision can easily be obtained, with a finer sub-division if necessary. If the designer wishes to explore in more detail the discontinuity where the dam meets the foundation and where the highest stresses usually occur, he can use the COBEF 3 program using block elements, with and without tensile stresses. It may be better to keep this type of analysis for special cases as, in a properly designed dam, the release of the tensile stresses that are almost inevitable at the heel, leads to an insignificant redistribution of the stresses in the dam and only slight changes in the existing compressive stresses. The programs COQEF 3 for thick shell analysis, and COBEF 3 with or without NOTEN 3 for no-tension conditions, can be considered as links in a chain of mutually compatible analyses for reliable and detailed exploration of an arch dam design. (Baker-IVI)
W84-01633

TUNISIA'S BOURGUIBA DAM AIDS REGIONAL DEVELOPMENT.
For primary bibliographic entry see Field 4A.
W84-01634

THIN ARCH DAM RESISTS ICE AND FLOODS,
Ministry of Water Conservancy and Power, Changchun (China).
W. Cai.
International Water Power and Dam Construction, Vol. 35, No. 8, p 37-39, August, 1983. 4 Fig.

Descriptors: *Arch dams, *Construction, Weathering, Floods, Ice, Dam construction, Water resources development.

Menkanshao power station on the Pushi River in the province of Lianoning consists of a thin arch dam, a tunnel, two penstocks, and a powerhouse. The catchment area is 198 sq km and the mean annual flow is 4.1 cu m/sec. The spillway design flood is estimated to be 1690 cu m/sec. The dam has withstood the sustained attacks of two floods larger than the spillway design flood and the extreme loading condition of ice thrust and freezing. The good performance of the dam is attributed to the reinforcement of the dam cylinder, particularly the heavier cantilever reinforcement. The principle of reinforcement is based on the assumption that stress in the arch direction is compression and the curved arch is flexible, while the cantilever, although free on the sliding joint, does experience moments in the lower part as a result of friction. Also moments may be produced because of uneven deformation and temperature variation. Since the cantilever is straight and shorter than the arch, it is stiller than the arch. Thus, considerable tension exists as indicated by computation. This is the reason why heavier reinforcement is placed in the cantilever direction. To improve performance in severe weather conditions, it is better to increase the cantilever reinforcement to about 0.1% of the cantilever section area, and the downstream face should be protected by an insulation layer. Also, it would be helpful to use electrical resistance wire buried in the sliding joint, to heat the joint and prevent it from freezing. (Baker-IVI)
W84-01636

FOR A RELIABLE WATER SUPPLY, COST COMES SECOND.
For primary bibliographic entry see Field 4A.
W84-01668

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Field 8—ENGINEERING WORKS

Group 8A—Structures

EXISTING SCHEMES FOR CONSTRUCTING HIGH CONCRETE DAMS AND WAYS TO IMPROVE THEM,
V. I. Teleshev, and V. K. Loshak.
Hydrotechnical Construction, Vol. 16, No. 10, p 527-533, October, 1982. 3 Fig, 3 Tab, 7 Ref. Translated from Gidroteckhnicheskoe Stroitel'stvo, No. 10, p 6-11, October, 1982.

Descriptors: *Dam construction, *Concrete, Concrete dams, High dams, Design criteria, Construction, Hydroelectric plants, USSR.

To fulfill the indicated needs and accelerate construction of large hydrostations with concrete dams, at the current stage of development of hydrotechnical construction in the USSR it is necessary to increase the rate of placing concrete to 2 million cu m/yr with consideration of the fact that hydrostations are being constructed in narrow sites with a markedly confined field of operations. This requires the development and introduction of new concreting technologies, further improvement of concrete-placing operations, including preparation of the block for concreting and the preparation, transportation, and placement of the concrete mix with appropriate mechanization of all types of operations, including within the block. There are ways to improve each of the existing methods of delivering concrete to the block. The most promising of these are the craneless layer-by-layer, cableway, and crane trestleless (stepwise) methods. (Baker-IVI)
W84-01737

ADVANCED ENGINEERING IN THE DESIGN AND CONSTRUCTION OF THE CHIRKEY HYDROELECTRIC STATION,
M. A. Mironov, V. I. Grech, and N. I. Chalyi.
Hydrotechnical Construction, Vol. 17, No. 1, p 1-10, January, 1983. 6 Fig, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 4-12, January, 1983.

Descriptors: *Construction, *Hydroelectric plants, Dam construction, Design criteria, Construction materials, Chirkey Hydroelectric Station, USSR.

The Chirkey hydrostation on the Sulak River in Dagestan ASSR is the most powerful hydrostation of the Sulak cascade and is intended to cover the peak-load part of the unified North Caucasian power system. The reservoir provided water for the development of irrigation agriculture on more than 300,000 ha, increased the water provision of water supply systems to a number of cities and towns, eliminated flooding of riparian lands in the lower reaches of the Sulak River and the need for annual reconstruction of protective embankments. A number of the engineering measures and technological methods successfully tested at Chirkey are presently being used elsewhere in the construction of large concrete dams and in the creation of turbine equipment for the powerful high-head turbines of the Nurek, Inguri, and Rogun hydrostations. In operation the Chirkey stations has an installed capacity of 1 million kW, possesses a 232.5 m high arch dam, and powerhouse with an original two-row arrangement of the units and has been proven to be a highly efficient structure. The developed and introduced layout design and industrial-technological measures made it possible to considerably reduce the amount of construction and installation works, to reduce the consumption of materials and cost of the structures, and to increase their reliability and operating qualities. The total saving from introducing just the main measures exceeded 20 million rubles. Among the most effective measures is the two-row layout of the units, the construction of a plug in the foundation of the arch dam with extension of the penstocks to the downstream face of the dam, the inclined intakes, and the new type of adjustable anchor support. The most important progressive industrial-technological measures are: the new technology of constructing concrete dams based on the use of cableways and a family of mechanisms for intrablock mechanization as the general concrete-placing and installing means; use of cantilevel type formwork of a new type; suspension technology of installing the embedded parts of the turbine; and excavation of rock cuts by the smooth splitting method. (Baker-IVI)
W84-01751

EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF THE SPILLWAY PART OF THE ZEYA DAM,
V. N. Vagner, and Ya. P. Mirzaev.
Hydrotechnical Construction, Vol. 17, No. 1, p 10-18, January, 1983. 7 Fig, 1 Tab, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 12-26, January, 1983.

Descriptors: *Construction, *Spillways, Design criteria, Dam construction, Concrete, Dams, Zeya Dam, USSR.

The buttress dam of the Zeya hydroelectric station with a crest length of 714 m, height of 116 m, upstream slope of 1:0.15 and downstream slope of 1:0.8 consists of bank abutments with a total length of 390 m, a powerhouse part with a length of 144 m, and a spillway part 180 m long. The dam buttresses within the bank abutments and spillway part have a thickness of 7 m and in the powerhouse part below the intake sill, 5 m. The recesses between the buttresses are, respectively 8 and 7 m. The recesses are covered by reinforced concrete slabs on the downstream face. According to laboratory studies the specimens of cavitation-resistant concrete M 400, MRZ 400 containing Portland cement M 400 and gravel of the fraction up to 40 mm with the addition of GKZh-94 placed in the spillway part of the Zeya dam showed stable results of strength, frost resistance, and cavitation resistance meeting the design requirements. The OVG-50 formworks for concreting the slab and RS-50 framework for the dividing wall used for constructing the spillway part of the dam provide the evenness and smoothness required by the design, are rather simple to handle, and are recommended for use. With the exception of the central part, construction of the monolithic spillway bucket is possible in the OVG-50 formwork. The central part of the bucket is concreted with the use of precast reinforced beams or panel formwork. The formation of the curvilinear surface of the spillway bucket from precast reinforced concrete beams permits simplifying concreting of the bucket with the obtainment of a good quality of the concrete surface, but further design developments are needed for reducing the cost and metal consumption of the works. (Baker-IVI)
W84-01752

PILE SELECTION AND DESIGN: LOCK AND DAM NO. 26 (REPLACEMENT),
B. H. Moore.
Transportation Research Record, Vol. 884, p 45-49, 1982. 8 Fig, 9 Ref.

Descriptors: *Piles, *Locks, *Dam design, Soil mechanics, Load distribution, Navigation, Decision making, Mississippi River, Illinois, Alton, Lock and Dam No. 26.

Lock and Dam No. 26 is a major navigation structure on the Mississippi River at Alton, Illinois. At the site there is a large, unbalanced horizontal water load of 24 ft. The soils at the site are sands, gravels, cobbles, boulders, and clay tills that are 80 ft. thick. The history of, and logic for, the selection of piling on this project is presented. The soil and foundation information available at each stage of design is outlined. The initial capacities were determined through experience and application of remote testing. The final choice of pile design was experience-based but supplemented by extensive explorations and on-site driving tests. At Lock and Dam No. 26, both testing and conservative design were used in developing the current plans. An evaluation of pile test extent and timing by using decision-analysis techniques is recommended. Until the driving and testing of production piles are complete, conservatism must govern design thinking. (Moore-IVI)
W84-01760

8B. Hydraulics

SPACING OF WELLS FOR HEAT PUMPS
Utah Water Research Lab., Logan.
C. G. Clyde, and G. V. Madabhushi.
Journal of Water Resources Planning and M ment, Vol. 109, No. 3, p 203-212, July, 1983. 3 Tab, 2 Ref.

Descriptors: *Well spacing, *Groundwate pumps, Breakthrough time, Groundwater ment, Anisotropy, Well yield, Water tempe Injection wells, Production wells.

An approach to selecting the spacing of w ground-water heat pumps is developed. through times for different well spacings ar lated taking into account typical ground-wa locities, well flow rates, and flow directions cal sizes of residential lots are given. Tab prepared to show ground-water temperatu the producing well for different times after through. Adverse conditions to be expected operation of the heat pump are described an remedial measures are suggested. In most a a spacing of 50 ft-75 ft (15.24 m-22.86 m) is s tory between the production and injection The space between neighboring heat pump s should be larger than the spacing between w densely populated locations the available ar not provide for adequate spacing of wells. I cases, the anisotrophy of most aquifers c utilized to good advantage by pumping ou the top of the aquifer and reinjecting at the t of the same well. (Author's abstract)
W84-01462

OPEN CHANNEL HYDRAULICS OF FI WITH INCREASING DISCHARGE,
Kuster und Hager A.G., Zurich (Switzerland
W. H. Hager.
Journal of Hydraulic Research, Vol. 21, N 177-193, 1983. 13 Fig, 2 Tab, 17 Ref.

Descriptors: *Channel flow, *Flow discharg drostatic pressure, Mathemetical models, S tion, Subcritical flow, Supercritical flow, C inflow, Channel morphology, Hydraulic jum

Based on a literature review, the most g equations are given for steady channel flow increasing discharge; one-dimensional flow a drostatic pressure distribution are assumed prismatic, rectangular channel with ar bottom slope and the non-prismatic, rectan nearly horizontal channel are investigated in One-dimensional theory and hydrostatic pr distribution allow relatively accurate simulat the flow. Inaccuracies may occur at the beg and at the end of the lateral inflow zone, because of the discontinuous variation of th charge. Transitions from subcritical to superc flow states are only formed in prismatic ch with relatively large bottom slopes. The st flow never changes in all other channels exc discontinuity (hydraulic jump). (Moore-IVI)
W84-01485

EROSION NEAR GROYNE-LIKE ST TURES,
Alberta Univ., Edmonton. Dept. of Civil neering.
N. Rajaratnam, and B. A. Nwachukwu.
Journal of Hydraulic Research, Vol. 21, No 277-287, 1983. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Groins, *Scour, Erosion, Flow trol, Bed load, Hydraulic models, Model st

Erosion near the nose of the groin is a probl considerable concern in cases where they been used in rivers. Experiments on clear- scour were conducted in a tilting rectan flume, 120 ft long, 3 ft wide and 2.5 ft deep groin used was an aluminum plate 3 mm projecting perpendicularly from the side wall length of 6 in. A 9 in. thick sand bed was prov In a typical test, uniform flow was first establ without the groin and then the flow was sto

in was installed and the flow was reestab-
When the eroded bed profiles became ap-
tely invariant, the profiles were used to
contour-type plots of the eroded bed. The
m depth of erosion was found to occur
nose of the groin. Based on this study, the
of the maximum depth of scour with time
n found to be similar. Further, the charac-
of the scour hole in the end state have also
nd to be similar. Some simple correlations
en developed for predicting the maximum
f clear-water scour in the end state for a
range of the relative width parameter.
IVI)
486

URES ON SPILLWAY APRONS DOWN-
M FROM PARTLY RAISED CREST

Inc., Montreal (Quebec).
ansford.
of Hydraulic Research, Vol. 21, No. 4, p
1983. 2 Fig, 3 Tab, 5 Ref.

tors: *Spillway apron, *Negative pressure,
gates, Cavitation, Mathemetical studies,
, Spillways, Vena contracta.

lytical study is made of pressures on a
apron downstream from a partly raised
d the results compared with experiment. A
n is to consider pressures produced by a
pe emerging on a parabolic (or trajectory
ron from a gate without contraction, i.e.
gate fitted with a hypothetical bellmouth
inlet. This case can be analyzed exactly,
power series development for the pressure
ction of time, or distance, after emergence.
lt obtained consists of the product of two
The first is an expression, Y(1-Z/H) for the
on the sill immediately after emergence
as to be expected, reduces to atmospheric
he operating head Z equal the design head
e parabola, i.e. the head for which the jet
the parabola exactly. The second factor
ts the reduction in pressure with distance
l after emergence. In the treatment of a
Y(1-Z/H) has to be integrated over the
of the gate opening, or more accurately
contraction coefficient C), over height CY.
ning a fixed center of curvature, a formula
d for the pressure which is closely related
rlier approximation suggested by Maitre.
ison with experiment suggests that this ap-
s in fact inadequate, and has prompted the
of the change of curvature occurring at
tion of the vena contracta, where surface
e becomes nil momentarily. The formulae
on this basis, one with a linear reduction
ture with height above the crest up to the
t the vena contracta, and the other assum-
adratic law of reduction, are shown to be
ory when compared with available data. A
duction of curvature with height appears
parabolic spillway best, but, for a Creager
tory type, with sharper curvatures toward
mit, the second quadratic type formula
more suitable. (Moore-IVI)
487

CTERISTICS METHOD USING TIME-
NTERPOLATIONS,

n Univ., Ann Arbor.
oldberg, and E. B. Wylie.
of Hydraulic Engineering, Vol. 109, No. 5,
3, May, 1983. 11 Fig, 17 Ref. PFR 80-

tors: *Hydraulics, *Waves, *Method of
ristics, Mathematical models, Water
, Interpolation, Time-line interpolation.

of interpolations in time, rather than the
idely used spatial interpolations, demon-
several benefits in the application of the
of characteristics to wave problems in
cs. Two such time-line schemes are pre-
nd analyzed in the solution of a linearized
mmer problem. Reachback time-line inter-
s, where the characteristic lines are pro-
ack before the current time step, demon-
strate less dampening than the correspondence spatial interpolation scheme at the same discretization. Implicit time-line interpolations, where the characteristic line is projected into the current time step, permit relaxation of the restrictive time step required by the Courant condition. An error analysis and numerical experiments demonstrate the degree of damping and dispersion introduced by both reachback and implicit time-line interpolation methods. The error analyses and their verification may encourage further application of these methods in appropriate problem domains. (Author's abstract)
W84-01541

INTERNAL FLOW IN HYDRAULIC JUMPS,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
J. A. McCorquodale, and A. Khalifa.
Journal of Hydraulic Engineering, Vol. 109, No. 5, p 684-701, May, 1983. 11 Fig, 29 Ref.

Descriptors: *Hydraulic jump, *Stilling basins, *Internal flow, Mathematical models, Hydraulic models, Velocity, Shear, Centrifugal force, Turbulence pressure, Boundary layer, Entrained air.

Most stilling basins are designed on the basis of small scale model tests. The Froude Law is normally used for scaling the data; however, the relative effects of viscosity, entrained air, and entrance boundary layers are significantly different in the model and prototype. A mathematical model has been developed to help in the prediction of prototype performance from physical models. The technique used here is an extension of the strip integral method of R. Narayanan. The strip integral method uses velocity shape functions to permit the partial integration of the equations of motion. A Gaussian velocity distribution is used in the mixing zone and the power law is used in the inner layer. The mathematical model includes the bed shear, turbulent shear, the potential core, entrained air, centrifugal force and turbulence pressure. The model gives a fairly good prediction of the jump length, roller length, velocity distribution, water surface and pressure at the bed. The prediction of the growth of the boundary layer was not very good. The model indicated that the main effect of entrained air is the bulking of flow. The effects of centrifugal forces and turbulence pressures start to become significant for initial Froude numbers greater than 5. (Moore-IVI)
W84-01542

APPLICABILITY OF DAM-BREAK FLOOD WAVE MODELS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
N. D. Katopodes, and D. R. Schamber.
Journal of Hydraulic Engineering, Vol. 109, No. 5, p 702-721, May, 1983. 9 Fig, 18 Ref.

Descriptors: *Flood waves, *Flood routing, Mathematical models, Open channel flow, Kinematic waves, Dam failure, Flood depth.

Mathematical models based on the Saint-Venant equations for open channel flow often encounter serious difficulties when applied to natural channels. On the other hand, the approximate flood routing models used in practice may yield results which are in gross error. In this work five mathematical models are constructed based on equations ranging from the complete dynamic system to a simple normal-depth kinematic wave equation. The results of the models are compared between themselves and with experimental data, in the form of free-surface profiles and stage hydrographs. The models are then converted to dimensionless form, which reduces the number of independent parameters controlling their solution. The results of these calculations are presented in the form of dimensionless plots of maximum flood depth and time vs. distance along the channel, for various levels of truncation of the open-channel flow equations. Estimates for the permissible range of application of the simplified routing models are given, and recommendations are made for their judicious application. (Author's abstract)
W84-01543

TURBULENT UNDERFLOW IN A SHORT CHANNEL OF LIMITED DEPTH,
University of Western Ontario, London. Faculty of Engineering Science.
R. E. Baddour, and H. Abbink.
Journal of Hydraulic Engineering, Vol. 109, No. 5, p 722-740, May, 1983. 13 Fig, 19 Ref.

Descriptors: *Underflow, *Channel flow, *Turbulence, Density stratification, Internal jump, Flow instability, Hydraulic models, Mathematical models, Mixing, Froude number.

The flow characteristics of a turbulent underflow in a horizontal channel of limited depth are explored analytically and experimentally under a variety of upstream and downstream control conditions. Freshwater and salt water are used in the physical model to simulate a stable density stratification, and a contraction is adopted as a downstream control device. Three typical flow situations, respectively, distinguished as drowned internal jump, free internal jump, and flow instability, are observed depending on the nature of the interaction between the upstream and downstream controls. The hydraulic properties of each one of the flow situations are reviewed, and the experimental observations are compared with the results obtained from a hydraulic analysis. Maximum turbulent mixing is demonstrated to occur at a particular value of the discharge densimetric Froude number. Further increase of discharge densimetric Froude number is expected to result in a decrease in turbulent mixing and eventually to provoke a flow instability. (Author's abstract)
W84-01544

CALCULATION OF A LOCAL SCOUR DEPRESSION NEAR A PROTECTED CONCAVE BANK OF A GRAVEL-PEBBLE CHANNEL,
V. A. Bazilevich.
Hydrotechnical Construction, Vol. 16, No. 10, p 547-554, October, 1982. 2 Fig, 1 Tab, 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 19-20, October, 1982.

Descriptors: *Channel scour, *Mathematical studies, Gravel, Pebbles, Depression, Scour, Abrasion, Erosion, Meanders.

A simplified calculation method was developed on the basis of analyzing the results of calculations by the complete method of the Institute of Fluid Mechanics to predict the depth of a scour depression at the toe of a protected concave bank of a meander in gravel-pebble channels and to determine the rate of this scouring. The main conditions making it possible to use the simplified calculation method are; disregard of the balance of the bed load, and the nonuniformity of the flow in the scour depression at the protected concave bank of meanders. To perform the calculation it is necessary to have the value of the average slope of the free surface of the water on the axis of the flow, which is assumed constant during deformation of the bottom of the meander. In the calculation one determines the vertically averaged velocity of the nonuniform flow and the friction velocity in the scour depression, which must be compared with the friction velocity corresponding to the detachment of the erosion pavement of inhomogeneous soil composing the bottom of the meander. To check whether the calculated deepening of the bottom can occur during the duration of the calculated flood on the basis of the value of the bed-load discharge, the rate of deepening of the bottom in the scour depression is determined with the use of a method provided. The reliability of the recommended simplified calculation method is confirmed by the results of comparing the calculated and experimental values. (Baker-IVI)
W84-01738

PRESSURE FLUCTUATIONS ON THE BOTTOM OF OPEN-CHANNEL TURBULENT FLOWS IN SPILLWAY STRUCTURES,
A. A. Ivoilov.
Hydrotechnical Construction, Vol. 16, No. 10, p 554-559, October, 1982. 3 Fig, 1 Tab, 10 Ref.

Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 23-25, October, 1982.

Descriptors: *Spillways, *Turbulence, *Hydraulic engineering, Construction, Pressure, Design criteria, Dam construction, Aeration.

Correct consideration of the hydrodynamic effect of a turbulent flow on elements of spillway structures is one of the important problems of modern hydraulic engineering. One characteristic of open-channel flows on high-head spillway structures is their severe aeration within the conveyance channel, and when the flow is ejected from the structure by means of a ski-jump bucket its considerable fragmentation during free fall is also noted. A theoretical analysis of the equations of hydrodynamics describing the motion of a water-air mixture shows that in this case, compared to the flow of a one-phase fluid, a number of additional factors have an effect, which can change the hydrodynamic characteristics of the flow. Pressure fluctuations on the bottom of the gradually varied and markedly nonuniform flow are reproduced sufficiently well on models of the structures, and the slight distortions of the energy-frequency spectrum caused by the nonmodelability of aeration and microturbulence of the flow can be disregarded. If it is necessary to conduct dynamic calculations of the structures, when a rigorous and spectrum-differentiated consideration of the pressure fluctuations is required, corrections obtained on the basis of the examined investigations can be introduced. The intensity of the pressure fluctuations on the bottom of the flow under the free-falling flow under prototype conditions compared to the model data noticeably decreases due to aeration and fragmentation of the flow, which for all practical purposes are not reproduced in the model. (Baker-IVI)
W84-01739

ON-SITE INVESTIGATIONS OF THE HYDRAULIC REGIMES OF A TRANSITION STRUCTURE,
P. V. Kutsenko, O. V. Kikish, and T. N. Rogovoi.
Hydrotechnical Construction, Vol. 16, No. 11, p 613-616, November, 1982. 1 Fig, 1 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 27-29, November, 1982.

Descriptors: *Channels, *Powerplants, *Water levels, Hydraulic machinery, Construction, Design criteria.

The design and operation of transition structures on channels of thermal and nuclear power stations should provide reliable, accident free operation of these structures. To maintain the necessary water levels and to join the pools a transition structure made in the manner of a tower spillway was constructed on the discharge channel at the Zaporozh'e state regional electric power station. The transition structure represents two unregulated spillways in the form of an overflow reinforced-concrete wall with heights of 2.46 and 2.6 m, thickness of 0.6 m, and total length of the spillway face of 75 m. Investigations of the hydraulic operating regimes of the transition structure were carried out in the fall of 1979 and the spring of 1980. During the first stage the investigations were conducted at various discharges of water through the structure into the lower pool and at a water level in the lower pool of the structure of 18.00 m. During the second stage the investigations of the hydraulic operating regimes of the transition structure were carried out at a constant discharge of 103 cu m/sec through it and with the water level in the lower pool of the structure raised to 18.55 m. A vacuum is created in the initial section of the discharge pipes of the transition structure, which explains the entrapment of air with water in them. Air accumulates in the pipes owing to the Archimedean buoyant force directed opposite to the flow of the water. It is possible to provide discharges under acceptable conditions if a vacuum is absent at the inlet section of the pressure pipes. (Baker-IVI)
W84-01744

HYDRAULIC INVESTIGATIONS OF FLOOD PASSAGE OVER A FLOODPLAIN AROUND CHANNEL STRUCTURES,
D. V. Shterenlikht, and I. F. Pikalova.
Hydrotechnical Construction, Vol. 16, No. 11, p 616-622, November, 1982. 4 Fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 29-32. November, 1982.

Descriptors: *Flood plains, *Channels, *Erosion, Hydraulics, Mathematical studies, Flood profiles, Construction, Design criteria.

Analytical and experimental investigations were conducted the movement of the flow over the floodplain around various types of channel structures. The experimental part of the work involved two flumes measuring 3.0 x 23.0 and 1.0 x 19.0 m in plan. The models were made of sand with concrete-crust coating and represented half of a parabolic channel with a rectangular floodplain adjacent to it. The experiments were conducted with three different values of the width of the floodplain and three values of its roughness coefficient. The floodplain did not have a transverse slope; the longitudinal slope of the floodplain and channel was 0.0012. Investigations of channel structures around which the flow passed were carried out at water discharges of low probability, when a single through-going flow is formed on the flood-plain and nonparallelism of the maximum velocity threads of the channel and floodplain flows is the least probable. The performance of nonoverflow guide groins on the floodplain was studied to create the most favorable conditions of streaming of the flow around the channel structures. Groins of an elliptical configuration shifted downstream relative to the site showed the best performance. Such an arrangement of the groins promoted a decrease of nonuniformity of the velocity distribution at the site of the structure and a decrease of maximum velocities in the immediate vicinity of the structure. (Baker-IVI)
W84-01745

HYDRAULIC LOADS ON THE SOLID BOUNDARY OF A FLOW UNDER THE EFFECT OF A FRAGMENTED JET,
L. D. Lentyaev, L. V. Smirnov, and A. G. Shubin.
Hydrotechnical Construction, Vol. 17, No. 1, p 28-31, January, 1983. 5 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 22-24, January, 1983.

Descriptors: *Fluid mechanics, *Jets, Nozzles, Fragmented jet, Hydraulic loading, Energy.

One of the main advantages of the scheme of joining pools by deflecting the jet compared to the scheme of dissipating the energy of the flow in a hydraulic jump is the substantially smaller level of dynamic loads on revetment elements of the lower pool due to fragmentation of the flow in the bay. Earlier recommendations concerning the structure of loading a solid boundary of a flow by fragmented falling jets of water when joining pools with deflection of the jet are confirmed by direct measurements of the dynamic reactions and can be recommended to hydraulic engineers for use in design practice when calculating revetment elements of lower pools of hydraulic structures. A schematic diagram of the experiments performed is provided. The jet of water, formed by a nozzle having a 0.2 x 0.5 m rectangular section and 1:4 contraction coefficient, which was fastened on a pressure tank, was discharged into a 4-m side horizontal flume with vertical walls equipped with an end device regulating filling of the flume in limits from 0 to 1.5 m. The head above the center of the nozzle was 2.3 and 7.7 m, which corresponded to nozzle discharges of 0.670 and 1.225 cu m/sec. The vertical distance from the nozzle axis to the flume bottom was 7.9 m. A the sensor of the total load a small steel beam was used, rigidly fixed on one end and free on the other. The beam-sensor was installed under the center of fall of the jet, flush with the flume bottom. (Baker-IVI)
W84-01753

SMALL STREAM CHANNEL DAM AERATION CHARACTERISTICS,
Illinois State Water Survey, Peoria. Water Qu
Section.
T. A. Butts, and R. L. Evans.
Journal of Environmental Enginering, Vol.
No. 3, p 555-573, June, 1983. 8 Fig, 8 Tab, 19

Descriptors: *Weirs, *Spillways, *Aeration, H
loss, Mathematical models, Hydraulic jump, D
Illinois.

Field data were collected at 54 small stream
loss structures in northeastern Illinois to eva
weir and spillway aeration characteristics.
British dam aeration equation, which employs
use of an aeration coefficient (b), is used as a m
to calibrate each head loss structure. The head
structures are categorized according to basic p
ical configurations; nine generalized classes
presented. The aeration coefficients vary wi
within classes due to seemingly small or s
differences in structural design or overall phy
condition. Spillways having the same basic
metric design may exhibit widely divergent
ation coefficients depending upon conditions a
toe or apron. Hydraulic jumps built into toes
duce significantly higher b-values than those
larly constructed but without hydraulic ju
The nine dam categories are assigned aeration
efficients which represent the median value
served within each grouping. These values
suitable for use in preliminary model develop
or when time constraints preclude making
surveys. However, whenever possible field sur
should be conducted using the methodology
sented as a guide. (Author's abstract)
W84-01768

8C. Hydraulic Machinery

**OPTIMUM CAPACITY OF A RUN-OF-RI
PLANT,**
International Engineering Co., Inc., San Franci
CA.
F. Fahlbusch.
International Water Power and Dam Construct
Vol. 35, No. 3, p 45-48, 3 Fig, Tab, 9 Ref.

Descriptors: *Capacity, *Decision making, *
construction, Mathematical studies, Powerpla

A rigorous formulation and an analytical solu
are presented to the problem of determining
optimum capacity of a run-of-river plant. Am
the evaluation criteria available, a maximizatio
the net benefit is generally considered as the
appropriate one. The net benefit is described as
difference between total benefits and total cost
is expressed in average annual terms. A ru
river plant may be viewed as a system w
converts a stochastic input process, streamfl
into a stochastic output process, power. The
proach does not suffer from usual shortcomi
but rather it shows that even an analytical solu
of the exact formulation exists. The resulting
pacity decision rule is simple to implement,
provides valuable guidance to judge the poss
effect of imprecise cost and benefit data on
design capacity. The objective function has
typical structure of the objective functions desc
ing single-period inventory decision probl
under risk. The distinguishing characteristic of
kind of problem is that there is only one opport
ty for procurement, scale or target decisions.
theory and results of this study may be applie
any hydro plant, with or without pondage, if
objective is maximum exploitation of energy
not the provision of peak capacity. (Baker-I
W84-01616

**FIRST PUMPED-STORAGE SCHEME F
THE PHILLIPPINES,**
National Power Corp., Manila (Philippines).
J. Polintan, and M. Pellaschiar.
International Water Power and Dam Construct
Vol. 35, No. 4, p 13-16, April, 1983. 4 Fig, 2 T

Descriptors: *Dam construction, *Decis
making, *Pumped storage, Powerplants, Hyd
electric plants, Phillipines, Kalayaan, Calir
Lake.

aan is an exceptionally positive site for the ation of a pumped-storage plant as it is ideal- ated, being only 15 km away from a large al plant. Its proximity to Manila has been a factor influencing the engineers concerned he project. Caliraya Lake, the upper man- reservoir, is connected to the Lumot reser- The combined normal active storage is about ,000 cu m with the water level from a mini- elevation of 286 m to a maximum of 288 m. ajor roles of the plant will be the transfor- of base energy to peak energy, and to the risk of the generating system of being to meet the demand. Other characteristics may be important in the operation of the nclude: the possibility of following very fast variations with a readiness unmatched by al peak generation facilities; the extremely tarting times; the possibility of passing rapid- n the pumping to the generating mode and ersa with the effect of improving the system lity in case of disturbances; and the possibil- operating as a synthronous condenser for the tion of reactive power and voltage. Devel- t of the project will be in the following the upper canal, the intake, the penstock, werhouse, the buildings, the switchyard, the nd the lower canal. (Baker-IVI)
1617

WORLD'S HIGHEST HEAD PUMP TUR- S,
a, Yokohama (Japan). Hydraulic Machinery

noda, K. Harada, and A. Yamakami.
ational Water Power and Dam Construction, 5, No. 4, p 17-21, April, 1983. 9 Fig, 1 Tab, 4

ptors: *Dam construction, *Pump turbines, criteria, Turbines, Engineering, Construc- lechanical equipment, Chaira Dam, Bulgar-

eversible pump-turbines have been manufac- or the Chaira scheme in Bulgaria which are orld's highest head single-stage machines. ingle-stage reversible pump-turbines each rated output of 216 MW in the generating with a rated speed of 600 rev/min and a g head of 701 m. The upper reservoir in the is created by the existing Belmeken dam usable storage capacity of 146,000,000 cu m, e lower reservoir, by Chaira dam with an ve water storage of 3,500,000 cu m. The vay consists of an underground system of , surge chambers, penstock and powerhouse s extending over a horizontal distance of 5300 m from the upper reservoir to the reservoir. (Baker-IVI)
1618

NCES IN PUMP-TURBINES DESIGN,
halmers Corp., York, PA.
Fisher, and J. R. Degnan.
ational Water Power and Dam Construction, 5, No. 4, p 21-26, April, 1983. 10 Fig, 1 Tab,

ptors: *Design criteria, *Pump turbines, onstruction, Computers, Turbines, Decision , Hydraulic design.

ystem and philosophy used to develop pump-turbine designs are reviewed. Design ves are to produce equipment which has the teristics of reliability, easy servicing, oper- flexibility and high performance. The suc- this approach is made possible by integrat- sign history and field experience into com- design and analysis systems. These systems latest analytical tools to provide a thorough tanding of hydraulic, mechanical and oper- behavior. They are supplemented by a ehensive set of statistics on existing units and operating problems. Extensive testing of and operating equipment provides further for design optimization and the feedback to make further improvements. Hydraulic improvements are pursued using a mean line performance prediction program to cal- culate both pump and turbine cycle performance as a function of wicket gate opening. Parametric studies of changes in water passage geometry are conducted and evaluated to maximize performance. Mechanical design refinements are studied using the finite element method. Two- and three-dimensional finite element method analyses are used to predict the static and dynamic structural response needed to achieve the desired reliability in the detailed mechanical design. An extensively correlated hydraulic transient program is used to evaluate and refine field behavior during the design process. Model test data, site water passageways, steady and dynamic loads and governor data are combined to predict machine behavior during start-up, load rejection, and operating mode change. Final refinements of operation are developed through comprehensive field tests during unit commissioning. (Baker-IVI)
W84-01619

MECHANICAL EQUIPMENT FOR DINORWIC.
International Water Power and Dam Construction, Vol. 35, No. 4, p 29-31, April, 1983. 3 Fig, 2 Tab.

Descriptors: *Mechanical equipment, *Fatigue, *Pumped storage, Dam construction, Storage, Turbines, Valves, Penstocks.

At the Dinorwic pumped storage station, equipment is designed to stabilize frequency variations; a machine may change from spinning to generation and back to spinning four or five times an hour. The design of the mechanical equipment such as pump turbines valves, and penstocks has been strongly influenced by the requirements to counter any problems of fatigue. A special program was developed for testing those components at risk, such as top and bottom covers of the pump-turbine spiral casings and elements of the main inlet valves. Components which were to be subjected to the fatigue inducing forces were examined ultrasonically, and the position and size of any imperfection were corrected. One unusual feature if the use of a Ringfeder locking assembly for the guidevane linkage. A simple arrangement of concentric tapered rings allows the guidevane link to slip at a predetermined torque higher than the normal operating value. Should material enter the water system and jam the guide vanes, the Ringfeder mechanism will prevent any of them from breaking loose from the assembly and causing damage to adjacent ones. Other components of the system that have unusual operating parameters are the main inlet valves which have to operate quickly and reliably, and if necessary, close without external power. (Baker-IVI)
W84-01620

OPTIMIZATION OF DREDGE AND VARIABLE DISPLACEMENT PUMPS,
P. R. Khlopenkov.
Hydrotechnical Construction, Vol. 16, No. 11, p 622-630, November, 1982. 6 Fig, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 33-37, November, 1982.

Descriptors: *Pumps, *Mechanical equipment, *Water delivery, Operation wastes, Energy, Dredging, Centrifugal pumps.

Nonproductive expenditures of electric energy occur at pumping stations with variable operating regimes; with a decrease of water consumption the head increases, whereas the network resistance decreases. As a consequence, the head exceeds the required values by 10-40% for the greater part of the day. This leads not only to an overconsumption of energy but also worsens the operating conditions of the network. The optimal solution is regulation of the head and delivery by changing the dimensions of the main operating elements of the pump by gradual variation of the outlet diameter of the impeller, or gradual variation of the width of the passages in the impeller and discharge pipe, or simultaneously by changing in certain combinations both the outlet diameter of the impeller and width of the impeller passages and discharge pipe. Centrifugal pumps with an adjustable outlet diameter and width of the impeller passage and discharge pipe were shown to improve operation of a given network and made it possible to reduce energy expenditures at pumping stations by 10-20%. By obtaining clean water directly from sludge and directly in the pump without pressure losses, it was possible to solve the problem of protecting pump elements from abrasion by a wall boundary layer without increasing energy expenditures on injecting clean water into the internal cavity of the pump. By fractionation of sludge in pressure settling tanks, without pressure losses, it was possible to use inferior borrow pits near hydrotechnical construction sites for reducing transportation expenditures on delivering inert materials to the site. (Baker-IVI)
W84-01746

IMPROVEMENT OF THE MECHANICAL EQUIPMENT OF HIGH-HEAD SPILLWAYS,
M. F. Krasil'nikov.
Hydrotechnical Construction, Vol. 16, No. 12, p 644-652, December, 1982. 8 Fig, 4 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 38-43, December, 1982.

Descriptors: *Spillways, *Mechanical equipment, *Gates, Construction, High pressure gates.

The problem of creating high-pressure gates for high-head powerstations has become acute in connection with expansion of the construction of hydrostations combining high heads with large waste discharges. Studies have been made in three principal directions to solve the problem: creation of reliable and effective designs of the main regulating and emergency guard gates for heads up to 200 m with an area of the opening being covered up to 60 sq m; creation of reliable and effective large-capacity lifting gear and with a large height of lifting the gates, supporting parts for large loads, and designs of gate seals with the use of new materials; the search for new layout designs of the surplusing works which effectively dissipate the excess kinetic energy of the high velocity flow beyond the main regulating gate to eliminate the destructive action of the flow on the structural part of the structure. The studies have demonstrated the real possibility and economic expediency of manufacturing mechanical equipment for regulating large waste discharges at a head of 200 m, and the effectiveness of using the effect of swirling of the discharging flow in spillway systems. Further perfection of the mechanical equipment of high-head spillways should improve the layouts, increase the precision and quality of manufacturing gates and drives, operating reliability of the seals, vibration resistance, and protection from cavitation. (Baker-IVI)
W84-01748

EVALUATION OF STRESSES IN ELEMENTS OF THE LOCK GATES ON THE MOSCOW CANAL,
V. G. Abrosimov, O. L. Bandin, A. P. Gusenkov, and V. P. Kogaev.
Hydrotechnical Construction, Vol. 16, No. 2, p 653-656, December, 1982. 3 Fig, 2 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 43-45, December, 1982.

Descriptors: *Lock gates, *Stress, *Evaluation, *Canals, Moscow Canal, USSR, Gates, Mechanical equipment, Mechanical failure.

Experience gained in operating the mechanical equipment of the Moscow Canal and certain other transporting hydraulic structures indicates that the reliable operation of engineering works is to a considerable degree determined by the strength of lock gates. The main elements of the gates include the load-bearing space truss consisting of riveted and welded elements, support elements, retaining elements and watertight skin plates. Atter several years of operation, cracks were found in the weld zone of the gates near the attachment holes in the retaining elements, in the angle flanges of the lower tie beam, and in the skin plate. On the basis of analyzing the working conditions of the elements of the lock gates and on-site strain measurements, the low cycle character of loading and

the possibility of failure in the maximally stressed zones was confirmed to be a consequence of the occurrence of repeated elastoplastic deformations in the structural material. It is necessary to calculate and determine experimentally the low-cycle life of elements of the load-bearing structures of lock gates and to work out recommendations on increasing their resistance to cyclic failure. (Baker-IVI)
W84-01749

8D. Soil Mechanics

THE EXCAVATION OF LARGE UNDERGROUND OPENINGS: A NUMERICAL SIMULATION,
Istituto Sperimentale Modelli e Strutture SpA, Bergamo (Italy).
M. Borsetto, and A. Peano.
International Water Power and Dam Construction, Vol. 35, No. 6, p 28-33, June, 1983. 9 Fig, 1 Tab, 34 Ref.

Descriptors: *Excavations, *Model studies, *Mathematical models, Rock excavation, Powerplants, Rock mechanics, Rocks.

The relative merits of various mathematical models used in the computations for constructing eight underground stations owned by the Italian power authority are discussed. The first attempt to use finite element models was based on the assumption of elastic material behavior. In the case of Lake Delio power station the aim was to identify the original stress state by fitting extensometer readings made during the excavation of the opening. Discrepancies lead to the development of more refined mathematical models. Hence the material was assumed to be linearly elastic under compression only: tensile stresses were redistributed according to the iterative method developed by Zienkiewicz. A realistic material model of the rock mass calls for a Mohr-Coloumb failure criterion, a strain softening law and a tensile cut-off. This approach was implemented in the computer program NOLIPL based on the stress transfer technique. The availability of realistic material models makes it possible to interpret the deformational behavior of the rock mass at various excavation stages and therefore it provides an adequate check of the design assumptions. To monitor the deformation occurring in the rock mass various rock extensometers are usually installed. A good agreement between the observed and expected performance of the opening confirms the designer's safety assessment. Some important cost- and time-savings procedures include reducing the size of the discretization by the boundary elements technique or by modelling the boundary conditions using infinite-finite elements; minimizing the number of degrees of freedom by using accurate approximation techniques based on high order polynomials; and tuning the algorithm for the solution of the system of linear equations on the basis of the characteristics of the hardware system. Typical aspects include a reduction in the paging in virtual storage computers and optimization of vector operations. (Baker-IVI)
W84-01625

MATERIALS FOR HIGH EMBANKMENT DAMS,
Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
V. I. Vutsel, Yu. K. Zaretsky, E. I. Vorontsov, A. G. Chernilov, and B. D. Chumichev.
International Water Power and Dam Construction, Vol. 35, No. 8, p 33-37, August, 1983. 6 Fig, 4 Ref.

Descriptors: *Dam construction, *Construction materials, Embankments, Soil properties, Testing procedures, Tensile stress, Stress.

In designing embankment dams the following main calculations are necessary: determination of the seepage stability of the dam body, its foundations, the banks and slopes; calculation of the settlement of the dam body and foundation to determine the required freeboard and the value of differential settlement of its different elements; calculation of horizontal displacements of the dam elements. The analysis for high (over 70 m), rockfill dams, used to determine their rational designs, should incorporate a considerable range of variations of stresses acting in the dam body. The stress, strain and stability analyses of high rockfill dams should take into consideration the real non-linear stress-strain relations. Analyses of soil materials are performed with the help of computers using programs based on the deformation theory of plasticity or the theory of plastic flow, and taking into account the possible consolidation of the clayey soils in anti-seepage dam elements, and the technique, sequences and time schedule of the construction program. Initial soil placement parameters are usually determined by the standard compaction method, involving the tamping of soils with different moisture contents at the standard impact impulse and the compacting effort. Strength and deformability characteristics of materials for anti-seepage elements are determined using the triaxial apparatus for testing specimens 60 and 100 mm in diameter. For assignment of the soil density, the concept of the relative compaction is used. (Baker-IVI)
W84-01635

EVALUATION OF THE ACCURACY OF CALCULATING THE STABILITY OF SLOPES OF EARTH DAMS IN CHECK CALCULATIONS OF SLOPES THAT FAILED,
N. A. Krasil'nikov.
Hydrotechnical Construction, Vol. 16, No. 10, p 560-567, October, 1982. 6 Fig, 5 Tab, 21 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 10, p 26-30, October, 1982.

Descriptors: *Earth dams, *Stability, *Mathematical studies, Dam construction, Dams, Slopes, Hydraulics, Soil properties, Computers.

To select the optimal method of calculating the stability of slopes of earth dams and to evaluate its accuracy, check calculations of the stability of more than 50 slopes that failed were performed. The calculations were performed on a computer simultaneously by several of the most used methods of calculation realizing the hypothesis of a circular-arc surface of sliding. These calculation methods are sufficient for conditions of earth dams. At present it is advisable to use the VNIIG-Terzaghi and Bishop methods in practical calculations of earth dams. Bishop's method, realizing Krey's model does not have any real advantages over the VNIIG-Terzaghi method. One of the slopes failed as a consequence of imperfection or inaccuracy of the calculation method. All failures of real slopes of structures occurred owing to the underestimation of the engineering-geological conditions of the foundation, insufficient consideration of the process of consolidation of the clay soil, or unfounded overestimation of the parameters of the shear strength of the foundation soil at the design stage. Therefore, the principal source for increasing the reliability of predictions of the stability of the slopes of earth dams lies in the timely refinement of the initial information. It is advisable to practice more widely the construction and investigation of experimental embankments in the preconstruction period. During further elaboration of problems of calculating the stability of earth dams it is advisable to use the achievements of the moden theory of landslide processes, bearing in mind that an earth dam works under specific conditions which are rarely found in nature. (Baker-IVI)
W84-01740

SOLAR RADIATION EFFECTS ON FROST ACTION IN SOILS,
C. W. Jones.
Transportation Research Record, Vol. 872, p 49-56, 1982. 12 Fig, 1 Tab, 6 Ref.

Descriptors: *Solar radiation, *Frost heaving, *Concrete technology, *Foundations, Canal linings, Soil temperature, Frost, Soil foundations, Canal drop structures, Coatings.

Engineers should be aware of solar radiation effects of frost action in soil foundations on the performance of surface structures. Damage to co
crete canal drop structures and lining from fr
heave on shaded sides in contrast to sun-expos
sides is described. To demonstrate passive so
effects on frost penetration, winter temperatu
were measured on the concrete surfaces and in t
soil subgrade beneath black-painted and unpaint
concrete linings on shaded and sun-exposed sid
of a small canal. Periodically, data on air tempe
tures, snow cover, and cloudiness were collect
and incident radiation and radiation reflected fr
the different concrete surfaces were measure
Frost penetrated 37 % less on the painted, su
exposed side than on the unpainted, sun-expos
side. Because of longwave, nighttime radiatio
frost penetrated 28 % more on the painted shad
side than on the unpainted shaded side. For t
unpainted concrete, frost penetrated 9-13 % less
sun-exposed than on shaded sides. (Author's a
stract)
W84-01756

**DESIGN OF CUT SLOPES IN OVERCONSOL
DATED CLAYS,**
V. C. McGuffey.
Transportation Research Record, Vol. 873, p 8-1
1982. 7 Fig, 4 Ref.

Descriptors: *Slope stability, *Seepage, *Groun
water level, *Clay, Slope degradation, Water tab
Soil mechanics, Hydrodynamics, Stress release.

Long-term cut-slope stability is directly depende
of seepage force and, therefore, the ultima
groundwater level within the soils in the cut. T
design of clay slopes for long-term stability w
studied in relation to mode of failure, soil te
methods, method of analysis, selection of para
eters, and time dependency of stability. Long-ter
safety of overconsolidated clay slopes can be es
mated by using the drained friction angle (plus
low residual cohesion) and seepage forces based
a high water table, determined by modified Bish
or a similar analysis. Stress release in overconso
dated clays is a time-dependent function, and
estimate can be made from the assumption of th
simple hydrodynamic lag model and a depth
failure plane based on the geometry of the mo
critical section. (Moore-IVI)
W84-01758

8E. Rock Mechanics and Geology

**FOUNDATION TREATMENT FOR INDIA'
SALAL DAM,**
B. R. Chadha.
International Water Power and Dam Constructio
Vol. 35, No. 8, p 53-56, August, 1983. 5 Fi

Descriptors: *Dam construction, *Rockfill dam
Foundation rocks, Grouting, Permeability, Indi
Salal Dam, Water resources development, Leal
age.

The Salal Dam is located in the northern loop
the Chenab river. The structure will be one of th
highest rockfill structures in the country. It i
volves placement of 8,000,000 cu m of compacte
materials, 96,000 m of grouting, and forms a majo
constituent of the Salal hydro project. The area
the right abutment consists of highly jointed dolo
mite with a number of shear zones and chart band
The left abutment of the dam is guided by th
bedding planes of the highly jointed dolomite
which strike almost in a transverse direction to th
axis and dip at 55 degrees northwards. A 50 mm
thick gunite has been applied to the full core bas
and on the downstream rock face of the cor
trench. In the reaches within the core trenc
where the permeability of the bedrock did no
reduce to 10 Lugeons after consolidation groutin
a 6 m deep concrete cutoff has been provided wi
a 1 m base width and side slopes of 4 V to 1 H an
a longitudinal slope of 1 V to 2 H. Grout intake i
the shear zones is not excessive because of th
presence of clayey material. High permeabilit
values in the upper stages could be attributed t
leakage through the weathered rock and the oper

it of joints to the surface. A drainage system
een provided on the downstream side of the
base in view of the shear zones running
el to the river course and the difficulty in
g them with cement grout. (Baker-IVI)
01637

NTIFIC BASIS OF THE DESIGNS OF THE
ERGROUND STRUCTURES OF THE
JN HYDROELECTRIC STATION,
Ilyushin, V. M. Mostkov, and L. G.
hii.
otechnical Construction, Vol. 16, No. 12, p
3, December, 1982. 6 Fig, 5 Ref. Translated
Gidrotekhnicheskoe Stroitel'stvo, No. 12, p
December, 1982.

ptors: *Hydroelectric plants, *Construction,
properties, *Stability, Geologic fractures,
Powerplants, Dam construction, Tunnels,
cks, Rogun hydroelectric station, USSR.

omplex of underground structures of the
hydroelectric station is unique not only in
but also in foreign practice of underground
echnical construction. In a geological re-
he zone of the site represents a single tec-
lock bounded by several faults. The seismic-
the zone of the hydrostation, and the entire
is rated at intensity 9. The total length of
derground workings is more than 60 km.
evelopment and scientific substantiation of a
r of new, nontraditional designs both with
to the design and layout of the structures
the methods of constructing them were
. A study of the stress state of the mass
the effect of longitudinal seismic waves di-
along the route of the structures was carried
investigating three dimensional models of a
rent optically inactive material with ce-
-in Polaroids between which was a thin
f optically sensitive material. Investigations
structure in the stretch where the tailrace
cross the channel of the Vakhsh River
d a determination of the load on the pipes
ie dam, which in this stretch rises to 250 m,
letermination of the forces in the structure
ie assigned loads. The extent of the load on
ucture in the river-crossing stretch was de-
ed by the method of modeling with equiva-
aterials. In order to decrease the normal
e of the soil several methods were pro-
the most expedient of which involved run-
defined sequence from a solid embankment
he construction part of the stretch. (Baker-

747

Concrete

RIENCE IN THE USE OF ROLLED CON-
,
y of Construction, Tokyo (Japan). River

se.
tional Water Power and Dam Construction,
, No. 3, p 40-44, March, 1983. 5 Fig, 3 Tab,

tors: *Dam construction, *Rolled concrete,
criteria, Engineering, Construction, Dams,
dams, Japan.

of rolled concrete in dam construction has
er of advantages, some of which apply
arly to Japan where the river flows are
and the transport of fill material would
ransport resources. The use of rolled con-
lls for a difference approach to dam con-
n. There is a way of determining the dam
ross section suitable for construction on
y inferior and weak foundation ground of
often encountered. In contrast to the arch
ie use of rolled concrete may be said to
stresses and make use of relatively weak
. Rolled concrete is mainly placed in a
tal plane as opposed to normal concrete
is applied at one point and therefore the
n of an appropriate equipment system is
portant. The fundamental aim when using rolled concrete is to adopt the concept of the conventional concrete gravity dam through the design. Through practical application of rolled concrete in dam construction, many of the apparent problems have been solved. This method was suitable for current conditions in the construction of gravity dams. The ease of placment is greatly enhanced by the considerable reduction in contraction joints or construction joints, and work on the placement area is also carried out more safely. The method has been successfully applied to dams as well as to appurtenant structures. The most appropriate types of dam to make use of the rolled concrete method are likely to be those where the plan area of the dam body is wide in proportion to the height and where there are few structures inside the dam body. (Baker-IVI)
W84-01615

CONSTRUCTING THE DRAKENSBERG PRESSURE TUNNELS,
For primary bibliographic entry see Field 8A.
W84-01623

HYDROTECHNICAL CONCRETE OF THE UST-ILIM HYDROELECTRIC STATION,
M. A. Sadovich.
Hydrotechnical Construction, Vol. 16, No. 11, p 598-605, November, 1982. 1 Fig, 5 Tab, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 19-23, November, 1982.

Descriptors: *Concrete, *Dam construction, Powerplants, Concrete construction, Concrete technology, Bratsk hydrostation, Ust-Ilim hydrostation.

The similarity of the climatic and engineering-geologic conditions of the construction of the Bratsk and Ust-Ilim hydroelectric stations and the participation of a common team of designers and builders in the construction led to a continuity of design, but considerable difference in hydrotechnical concrete used at both sites. A decrease of cement contents compared to analogous compositions of the Bratsk hydrostation, improvement of concrete quality, and increase in general technological discipline attest to definite progress in the technology of hydrotechnical concrete used at the Ust-Ilim hydrostation. Further progress was noted with the selection of a rational technology on the basis of experience at the Bratsk and Ust-Ilim stations, modernization of individual components, and the creation of a system of automatic compensation of the variability of the moisture content of aggregates at concrete plants, mechanization of concreting operations in the blocks, and increases of general efficiency. Site tests of the concrete of the Ust-Ilim dam showed that the solid concrete mass was particularly impermeable and the relatively small seepage flow occurred along the cracks and horizontal joints. One of the directions of the rational use of concrete can be a further reduction of the cement contents in concrete of the upstream column to an extent which does not cause damage when used as a material and will promote an increase of crack resistance of individual blocks and structures as a whole. Analysis of test results indicated that it was necessary to take into account the conditions of hardening of the concrete in the structure when assigning the concrete composition. In massive and underwater structures, concretes with low cement contents harden most intensely and for the longest time. The strength reserves occurring in this case remain unused. In outer surface zones, conversely, early drying and other unfavorable factors can lead to a decrease of the potential possibilities of concrete. (Baker-IVI)
W84-01742

STRUCTURE AND FROST RESISTANCE OF SAND CONCRETES WITH CHEMICAL ADDITIVES,
L. B. Gol'denberg, S. L. Oganeyants, and G. F. Voevoda.
Hydrotechnical Construction, Vol. 16, No. 11, p 606-608, November, 1982. 1 Fig, 3 Tab, 3 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 11, p 23-25, November, 1982.

Descriptors: *Concrete technology, *Concrete additives, *Freezing, Frost, Concrete, Dam construction, Construction materials, Cold regions.

The introduction of chemical additives, changing the initial water content of the concrete mix and kinetics of the structural formation of concrete, have an effect on its porosity and, consequently, on frost resistance. The structure and frost resistance of sand concretes were studied after the addition of the additives superplasticizers S-3 and NIL-20, the set-accelerator sodium sulfate, and combined additives composed of them. The introduction of plasticizing and combined additives causing a decrease of the initial water content of the cement sand mixtures from 210 to 180-185 l/cu m and an increase of the unit weight of concrete from 2315 to 2350-2360 kg/cu m leads to a decrease of the total volume of pores of the concrete from 16.2 to 12.9-13.2%. The addition of sodium sulfate did not have a substantial effect on the porosity. A reduction of the volume of open capillary porosity should lead to an increase of the frost resistance of concrete, which was demonstrated in further testing to be the case. The coefficient of frost resistance after 300 freeze-thaw cycles for concretes without an additive or with only an accelerator is 0.92-0.94 and for concretes with plasticizing and combined additives 1.00-1.20. The results obtained on analyzing the relation between frost resistance of concrete and its structure are comparable to the results obtained on the basis of direct tests. The introduction of chemical plasticizing and combined additives S-3, NIL-20, S-3+SS, NIL-20+SS, causing a decrease of the initial water content, leads to modification of the structure of concrete, decreasing the volume of open capillary pores, and increases the frost resistance of concrete. (Baker-IVI)
W84-01743

ON-SITE OBSERVATION OF THE CONCRETE STRUCTURES OF THE KAKHOVKA HYDROELECTRIC STATION,
S. Ya. Eidel'man.
Hydrotechnical Construction, Vol. 16, No. 12, p 657-663, December, 1982. 5 Fig, 4 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 46-49, December, 1982.

Descriptors: *Concrete, *Hydroelectric plants, Construction, Failure, Stress, Dam construction, Dams, Kakhovka Hydroelectric Station.

The first unit of the Kakhovka hydroelectric station, whose total capacity is 321 MW, was started up 25 years ago. Settlements of the concrete structures of the hydrostation, which are diminishing, have been drawn out over more than 20 years. An increment of the settlement in recent years on some structures has ceased. The exception is one section of the downstream dolphin of the navigation lock located on an insufficiently compacted sand foundation bed. The greater part (80-90%) of the seepage head on the dam is lost on the blanket part of the underground contour, including the natural blanket of liman-marine silts. On the upstream sheet-pile wall 10-12% of the head is lost. The piezometric levels vary almost as a linear function of the fluctuations of the lower pool level. The character of the diagram of contact stresses in the bed soil, which is governed by the sequence of concreting the dam and increase of the upper pool level during filling of the reservoir, remained stable during the subsequent years of operation. A slight increase of contact stresses was noted at certain points of the bed under the indent of the dam. The stresses in the reinforcement of the massive foundation slabs are small. In the vertical reinforcement of the retaining walls the thermal stresses of the construction period reduced the tension on the back side and increase compression on the face side. Tensile stresses up to 140 MPa were measured in the reinforcement of the spiral casing after filling it with water. String-type sensors were installed in the concrete structures without the use of vulcanization of the joints of the cables. This and also the shortcoming of the design of the sensors resulted in their gradual failure. However, about 150 sensors that remained sealed have been operating for more than 25 years in the

concrete and saturated bed sands, and their readings are reliable. (Baker-IVI)
W84-01750

SOLAR RADIATION EFFECTS ON FROST ACTION IN SOILS,
For primary bibliographic entry see Field 8D.
W84-01756

8G. Materials

HIGH TENSILE STRENGTH STEEL FOR PENSTOCKS,
Wakayama Steel Works, Minato (Japan).
K. Maruyama.
International Water Power and Dam Construction, Vol. 35, No. 3, p 33-35, March, 1983. 5 Fig, 3 Tab.

Descriptors: *Steel, *Construction materials, *Penstocks, Dam construction, Dams, Japan, Bulgaria, Yugoslavia.

Large-scale dams and power stations, particularly pumped-storage plants, require penstocks of larger diameters and strengths to cope with the higher heads of water currently being exploited. The characteristics, of various types of high tensile strength steel manufactured in Japan for large scale penstocks are described. The use of HT (high tensile) steel plates means that the allowable stress can be higher, and the wall thickness of the penstock can be reduced compared with lower strength steel plates. The reduction in wall thickness results in direct and indirect cost reductions and lead to economics in the following areas: transport and installation as the weight is less; fabrication and welding which will be easier; and material savings as less will be required. Penstock pipes can be classified according to shape. HT steel plates are either used for part or all of the penstock, depending on the maximum hydraulic pressure on each part of the pipes. Fundamental requirements for penstock plate quality include: weldability - low preheating temperature and high maximum heat input; workability; fracture toughness; and inner quality. Examples of HT steel applications are found in Bajina Basta, Yugoslavia; Chaira, Bulgaria; and Imaichi, Japan. (Baker-IVI)
W84-01614

8H. Rapid Excavation

DIRECTIONAL BLASTING IN ROCKFILL DAM CONSTRUCTION,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
V. P. Nedriga, G. I. Pokrovsky, and N. P. Lushnov.
International Water Power and Dam Construction, Vol. 35, No. 6, p 37-40, June, 1983. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Excavation, *Dam construction, *Directional blasting, Reservoirs, Construction, Environmental effects, Economic factors, USSR.

Directional blasting is frequently used in dam construction in the mountainous regions of the USSR in order to shorten the construction time, reduce the labor content, provide considerable economies and help in the protection of soils in dams constructed by blasting operations. Those mountainous rivers favorably disposed to such treatment are characterized as follows: the gorge in the dam site is sufficiently narrow for the ratio of its width at the crest level to its height is not more than 2:3 with slopes of 30 degrees; the rock of the valley is suitable for placing in the dam body; the quantity of rock material which needs to be placed in the dam body must be somewhat higher than normal upper value with the optimum configuration within the construction site; and the sides of a valley must be easily cleared from humus, skeery and loose crumble. A homogeneous dam is a mass of rocks piled on the given site of a riverbed by directional blasting. Such dams usually have considerable permeability. A composite dam having face, or a face and a blanket is placed by both directional blasting in the downstream section and the usual operations used for transition zones, with faces of fine-grained and cohesive soils respectively. A hydroblasted dam consists of upstream and downstream sections placed by blasting, but the central core of impermeable soils is placed by hydraulic fill. Sometimes it is worthwhile constructing the antiseepage sections also with the help of directional blasting. The density of any coarse-grained material placed in a dam body depends on two factors: grain-size distribution of materials and methods of compaction. In this application the grain-size distribution of soils is characterized mainly by natural fissuration of the rock at the dam site, blasting operations and partly by the mechanical properties of the rock mass itself. The change in the grain-size because of falling after the explosion is insignificant and inherent in coarse rocks; in any case the amount is generally small. (Baker-IVI)
W84-01626

8I. Fisheries Engineering

MORTALITY OF JUVENILE SALMONIDS PASSING THROUGH OSSBERGER CROSSFLOW TURBINES AT SMALL-SCALE HYDROELECTRIC SITES,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
S. P. Gloss, and J. R. Wahl.
Transactions of the American Fisheries Society, Vol. 112, No. 2A, p 194-200, March, 1983. 4 Fig, 1 Tab, 10 Ref. 14-16-0009-80-1004.

Descriptors: *Turbines, *Mortality, *Salmon, *Trout, Fish migration, Fish size, Juvenile growth stages, Hydroelectric plants, Ossberger Crossflow turbine.

Experiments were conducted on Ossberger Crossflow turbines to determine the amount of mortality that would be incurred by downstream-migrating juvenile salmonids passing through these turbines. Species tested were Atlantic salmon Salmo salar, and rainbow trout and steelhead Salmo gairdneri. A highly significant ($P<0.01$) relationship between fish size and arc sine square root of mortality was found. Regression equations were calculated to predict expected mortality through 48 hours based upon size of fish. Mortality ranged from 15% for 85-mm fish to over 70% for 280-mm fish. No significant differences in mortality existed among similar size-groups of the three salmonids tested. Neither output of the turbine nor its size (650 versus 850 kilowatts) affected the amount of mortality. Temporal distribution of mortality after fish passed through the turbine was not different among species nor was it affected by the absolute rate of mortality in a given trial. Over 75% of the mortality was considered instantaneous. (Author's abstract)
W84-01402

LARVAL FISH TRANSPORT: A CASE STUDY OF WHITE BASS,
Tennessee Valley Authority, Knoxville. Div. of Water Resources.
L. B. Starnes, P. A. Hackney, and T. A. McDonough.
Transactions of the American Fisheries Society, Vol. 112, No. 3, p 390-397, May, 1983. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Larvae, *Fish behavior, Downstream transport, Velocity, Entrainment, Bass, Hydraulic transport, River flow.

Larval white bass Morone chrysops resisted downstream transport in the Holston River, eastern Tennessee. Despite a short hydraulic-transport time (<20 hours) through the study area (19.8 km), larvae were not transported downstream and out of this region soon after hatching. Recently hatched larvae were collected near a dam that blocks migration of spawning adults at the upper end of the study area; however, downstream from the dam larvae were significantly larger (and older) than expected if they had been transported passively through the area. Larval white bass pr ably remain near bottom or in other low-velo refugia that effectively reduce downstream placement. Hybrid striped bass Morone saxatil white bass larvae 4 mm and longer oriented stream in a laboratory flume; they swam orously and utilized areas of low current velo to reduce downstream displacement. Retar downstream transport found in the riverine e ronment, coupled with laboratory observatio implies that improvements are needed in mo used to estimate entrainment of fish larvae. (A thor's abstract)
W84-01415

MULTIPLE REGRESSION ANALYSIS F FORECASTING CRITICAL FISH INFLUX AT POWER STATION INTAKES,
Central Electricity Generating Board, Faw (England).
A. W. H. Turnpenny.
Journal of Applied Ecology, Vol. 20, No. 1, p 42, April, 1983. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Fish populations, *Entrainme *Powerplants, Cooling water, Regression anayl Statistical models, Fish impingement, Water te perature, Tides, Wind speed.

Certain coastal power stations in Britain are s ject to ingresses of fish which may jeopardize pl operation or which may cause temporary lo depletion of fish populations. There have b attempts in the United States and in Europe develop costly and often ineffectual exclusion vices. As an alternative, it is proposed that, sites where the problem is intermittent, statisti models should be developed which allow criti levels of fish ingress to be predicted and the nec sary reduction in cooling water flow determin The procedure for developing a multiple regr sion model is described and illustrated using f impingement data collected from Fawley Pow Station. Over 60% of the overall variation v accounted for in terms of a small number of eas measured variables (cooling water flow, wa temperature, tide height, wind speed). In ot research work, values of up to 80% have b quoted. With refinements of the model formulati higher values should be possible and the approa then would have practical application. (Autho abstract)
W84-01440

RESTORATION OF A DISUSED DOCK BAS AS A HABITAT FOR MARINE BENTHOS A FISH,
Liverpool Univ. (England). Hartley Botani Labs.
G. Russell, S. J. Hawkins, L. C. Evans, H. D. Jones, and G. D. Holmes.
Journal of Applied Ecology, Vol. 20, No. 1, p 58, April, 1983. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Estuarine environment, *Marine fi *Marine plants, Water quality, Habitats, Destrat cation, Salinity, Water temperature, Oxygenati Trace metals, Mytilus, Artificial habitats.

Changes in the water quality, and in flora a fauna, of a Liverpool dock have been monitor since closure of its gates in 1977. Water salinit have been found to fall within the range 25-31 and temperatures 0.3-19 degrees C. Secchi d extinction depths averaged 5-6 m in the dock a 10 cm in the Mersey estuary outside. An air- pump has been installed which prevents stratifi tion during summer and ensures an oxygen-ri water column. The absence of harmful dinoflag late blooms is attributed to artifical destratificati by this method. Improvements in water qual have been accompanied by the development o more diverse marine flora and fauna than in otl unclosed docks. The benthic community is dor nated by Mytilus edulis. Trace metal concent tions and coliform bacterial counts in Mytilus fle are sufficiently low for the animals to comply w existing food safety regulations. Introduced Lam aria saccharina grew until water temperatu reached 15 degrees C, but a few plants survive

eek period in summer 1981 when ambient r temperatures were above 15 degrees C. It is uded that a dock of this character can be ained as a productive marine environment a variety of educational, amenity and eco- uses. (Author's abstract)
01441

GN OF HABITAT STRUCTURES FOR N CHANNELS,
Engineer Waterways Experiment Station, burg, MS. Environmental Lab.
Shields, Jr.
al of Water Resources Planning and Manage- Vol. 109, No. 4, p 331-344, October, 1983. 1 Tab, 32 Ref.

riptors: *Habitat structures, Aquatic habitats, Current deflectors, Boulders, Channel modifi- , Channeling, Stream biota.

any cases, channel modifications have ex- ly adverse impacts on aquatic communities. Rudimentary design guidelines are presented for simple structures (sills, current deflectors, and individual boulders) used to accelerate biological recovery of modified stream channels. These structures increase the physical habitat diversity of a modified channel. Data from nine case studies are presented in tabular form, including stream channel characteristics, structure dimensions, and an analysis of biological effectiveness and structural durability. Available literature on habitat structures focuses on applications to unenlarged cold-water streams with coarse bed material. Documented experience with enlarged warmwater streams that have poorly armored channels is extremely limited. (Author's abstract)
W84-01469

FINDING SALMON AND TROUT IN LAKE ONTARIO,
State Univ. of New York Coll. at Brockport.
J. M. Haynes.
Water Spectrum, Vol. 15, No. 1, p 30-37, Spring, 1983. 11 Fig.

Descriptors: *Fishing, *Lakes, *Telemetry, Data collecting, Fish, Population dynamics, Trout, Salmon, Lake fisheries, Water temperature.

Radiotelemetry and vertical gill netting were used to obtain knowledge about the whereabouts of some species of fish during certain seasons of the year in Lake Ontario. Particular attention was given to the chinook salmon. Salmon and trout move great distances during seasons when they are nearshore. Summer netting revealed that steelhead/rainbow trout and Pacific salmon are widely dispersed and far offshore, while lake and brown trout are concentrated in narrow temperature preference bands associated with the thermocline, lake bottom, and nearshore regions. It is felt that such studies will bring new research approaches to solve problems for the Great Lakes fishing industry and help in restoring economic and ecological health to the region. (Baker-IVI)
W84-01641

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A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 6
JUNE 1984

W84-01770 -- W84-02124

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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ter Resources Research, Vol. 19, No. 4, p 909-, August, 1983. 3 Fig, 32 Ref. NSF grant CME-6577.

scriptors: *Statistical methods, *Hydrology, ovariance, Variance, Rainfall, Error analysis, del studies, Network design.

ree methods for the estimation of the parameters he polynomial generalized covariance function useful model for nonstationary functions) are sented and evaluated: maximum likelihood L), minimum variance unbiased quadratic VUQ), and minimum norm (least squares). The mation error covariance matrix of the param-s is calculated with each of these methods. ML MVUQ estimation have very good properties , for reasonably large samples, give very similar lts. Minimum norm estimation is appropriate preliminary data analysis. The application of e methodologies is illustrated with a set of fall data. The estimation of the parameters of covariance function involves sizeable errors. In ctice, it may be rather difficult to identify the ameters of all but simple models. The proposed ameter estimation methods can be very useful in luating and accounting for the effect of parame-uncertainty in the design of hydrologic data ection networks. (Moore-IVI)
4-01884

THEMATICAL SIMULATION OF INTER- PENDENT SURFACE AND SUBSURFACE DROLOGIC PROCESSES,
nce and Education Administration, Fort Col- CO. Agricultural Research.
E. Smith, and R. H. B. Hebbert.
er Resources Research, Vol. 19, No. 4, p 987-, August, 1983. 21 Fig, 23 Ref.

criptors: *Storm seepage, *Slopes, *Infiltra-, Permeability coefficient, Hillslopes, Mathe-ical models, Simulation, Hydrodynamics, Soil er, Perched water, Unsaturated flow, Rainfall-off relationships, Western Australia.

athematical model is introduced which repre-s an attempt to integrate all of the major hy-ogic response mechanisms presently identified ontributing to the hydrology of a simple hills-, by selecting efficient approximations for key ents in hillslope hydrodynamics: infiltration movement in the unsaturated flow zone. The lope is considered to consist of two soil layers the lower soil capable of restricting vertical at the interface to create a perched aquifer subsurface stormflow. The slope of the inter- is arbitrary. A kinematic method for routing turated vertical flow is linked consistently a modern analytically derived infiltration el, which operates when rainfall exceeds sur- saturated hydraulic conductivity Ks. The el is used to demonstrate several of the rela-ships between rainfall flux, soil hydraulic prop-s, hillslope geometry, and runoff characteris- The model is also applied to simulate experi-tal data from a hillslope in Western Australia. ical movement in the perched water table g the hillslope and primarily in the near-stream on is potentially more significant in most hills-s than horizontal flux of the resulting perched fer. Subsurface stormflow recession character-s are probably much more related to the loss ern into the subsoil of spatial variability of eability in the surface soil zone than to a acteristic response function of the aquifer hy-lics. The dynamics of the saturated excess onse and the subsurface stormflow are both ily influenced by conditions such as gradients, r table heights, soil depth, and saturations. Subsoil response delay time is largely controlled by the depth of the unsaturated zone. Multiple peaks may be produced from a relatively uncomplicated hyetograph when the expansion of the saturated excess zone interacts with the changes in the rainfall rate. (Moore-IVI)
W84-01892

CALIBRATION OF SNYDER COEFFICIENTS FOR PENNSYLVANIA,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
A. C. Miller, S. N. Kerr, and D. J. Spaeder.
Water Resources Bulletin, Vol. 19, No. 4, p 625-630, August, 1983. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Surface runoff, *Unit hydrographs, *Pennsylvania, Rainfall-runoff relationships, Regression analysis, Storm runoff, Maps.

Unit hydrograph theory is one of the most widely used techniques to predict surface runoff. The present study is concerned with the Snyder unit hydrograph and the calibration of the Snyder coefficients for Pennsylvania. Twenty-seven study basins were selected, located randomly across the state. With the rainfall and runoff recorded for several events for each basin (more than 500 events were analyzed) unit hydrographs were calculated and the Snyder coefficients determined. A map of the coefficients was drawn to illustrate the variability in the coefficients and two equations using multiple regression theory were developed. The unexplained variability of the coefficients suggests that upper and lower bounds on the peak flow might be placed on storm hydrographs developed for ungaged watersheds. (Author's abstract)
W84-01949

ALTERATION OF OCEANIC CRUST AND GEOLOGIC CYCLING OF CHLORINE AND WATER,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
E. Ito, D. M. Harris, and A. T. Anderson, Jr.
Geochimica et Cosmochimica Acta, Vol. 47, No. 9, p 1613-1624, September, 1983. 3 Fig, 5 Tab, 116 Ref.

Descriptors: *Water cycle, *Geohydrology, *Chlorides, *Geochemistry, Subduction, Hydrothermal studies, Volcanoes, Water transport, Solute transport, Plate tectonics, Geologic cycling, Oceanic crust, Magma, Ocean bottom.

New estimates of transport rates for H2O and Cl between the mantle and surface reservoirs are reported. The estimates take into consideration alteration of oceanic crust, especially that of plutonic rocks, and possible subduction of sediments. The effect of (hydrothermal) alteration on the Cl budget seems to be negligible, but the effect on the H2O budget is significant. Altered oceanic crust (excluding sediments) contains about 10 times as much H2O as the unaltered crust, and its subduction may result in a net transport of H2O to the upper mantle in subduction zones. However, the rate of expulsion of H2O from the mantle by subduction-zone magmatism is comparable to the amount released by ridge magmatism, and is only about 10% of the amount subducted. Therefore, about 90% of the subducted H2O must be returned to the mantle or returned to the crust by other processes. In addition, subduction of oceanic sediments to mantle depths will result in a further increase in the return rate of H2O to the mantle reservoir, and possible net transfer of Cl to the mantle, depending on the rate of pore water expulsion. The reflux of subducted H2O to the surface reservoirs is not fully accounted for by igneous activity at volcanic arcs in subduction zones, or mantle H2O associated with igneous acitvity at oceanic spreading centers and hotspots. (Moore-IVI)
W84-01986

THROUGHFALL AND STEMFLOW IN THE FOREST NUTRIENT CYCLE,
G. G. Parker.
Advances in Ecological Research, Vol. 13, 1983. 14 Fig, 5 Tab, 280 Ref.

Descriptors: *Cycling nutrients, *Precipitation, *Throughfall, *Stemflow, *Forests, Minerals, Forest soils, Leaching, Dry deposition, Washoff.

The quality of precipitation falling on forests is altered during a brief but significant interaction with the surfaces of plants, resulting in the transfer of additional mineral matter to the forest floor. While incident precipitation is the largest nutrient input to many forests, throughfall fluxes are substantially greater, ranging from 1.27 (for NO3-N) to 11.2 times as high (for K). These alterations in nutrient concentrations involve numerous processes and combine materials originating both within (biotic) and outside of the forest ecosystem (atmospheric). The resulting flux is a pathway of rapid mineral cycling, a route for transferring metabolic biproducts and substances of allelochemic and pedogenic importance and a method for washing the air filtering surfaces of the forest canopy. Throughfall and stemflow are major pathways in nutrient recycling. The annual nutrient return to the forest soil for the elements K, Na and S is predominantly via throughfall and stemflow and little due to litterfall. Stemflow transfers only 5-20% of the total in precipitation-borne solutes, yet it is the major nutrient input to restricted areas of the forest floor. Incident precipitation is an underestimate of input and net forest water is an overestimate of canopy-mediated recycling. Without estimates of dry deposition and subsequent washoff, nutrient cycles are unbalanced and atmospheric losses poorly quantified. Throughfall and stemflow show much variability in concentration and deposition, far more than for incident precipitation. Sampling and analyses of forest waters present special chemical and statistical problems. For nutrient budgets, a major difficulty lies in obtaining an accurate and independent estimate of the forest hydrologic budget. For the majority of elements, leaching is the major contribution in net throughfall. (Moore-IVI)
W84-01987

MODEL STUDY OF THE SHORT-TERM CLIMATIC AND HYDROLOGIC EFFECTS OF SUDDEN SNOW-COVER REMOVAL,
National Oceanic and Atmospheric Administration, Princeton, NJ. Geophysical Fluid Dynamics Lab.
T.-C. Yeh, R. T. Wetherald, and S. Manabe.
Monthly Weather Review, Vol. 111, No. 5, p 1013-1024, May, 1983. 16 Fig, 13 Ref.

Descriptors: *Snow cover, *Soil water, *Climate, Albedo, Mathematical models, Simulation, Evaporation, Soil temperature, Air temperature, Insolation, Atmospheric circulation.

This paper describes the results from a set of numerical experiments which simulate the effect of a large scale removal of snow cover in middle and high latitudes during the early spring season. This is done through use of a simplified general circulation model with a limited computational domain and idealized geography. It is found that removal of snow cover reduces the water available to the soil through snowmelt and decreases soil moisture in this region during the following seasons. Furthermore, it also reduces surface albedo in this region and increases adsorption of insolation by the ground surface. This, in turn, heats the ground surface and allows more evaporation to occur. However, the change of evaporation is relatively small owing to the low values of surface temperature in high latitudes. Therefore, the negative anomaly of soil moisture induced initially by the removal of snow cover persists for the entire spring and summer seasons. The removal of snow cover also affects the thermal and dynamical structure of the atmosphere. It is found that the increase of surface temperature extends into the upper troposphere thereby reducing both meridional temperature gradient and zonal wind in high latitudes. (Author's abstract)
W84-02042

2B. Precipitation

A MILLIMETER-WAVELENGTH DUAL-POLARIZATION DOPPLER RADAR FOR CLOUD AND PRECIPITATION STUDIES,
National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
F. Pasqualucci, B. W. Bartram, R. A. Kropfle, and W. R. Moninger.
Journal of Climate and Applied Meteorology, Vol. 22, No. 5, p 758-765, May, 1983. 7 Fig, 1 Tab, 17 Ref.

Descriptors: *Precipitation, *Radar, Climate Storms, Clouds, Meteorological data collection, Micrometeorology, Montana.

A pulse Doppler radar system operating at 35 GHz and having full polarization (linear and circular) diversity capability is described. Separate antennas are used for the transmitter and the receiver because this design approach allows better overall radar sensitivity. The transmitter operates in the double-pulse mode to optimize the unambiguous Doppler velocity measurable with the system. A polarizer capable of handling about 200 kW of peak power when pressurized with sulfur hexafluoride at 25 psi was developed for the transmitter. The radar system has built-in test sequences for checking the gain and alignment of the transmitter and receiver antennas. The dual-polarization intermediate frequency receiver has a total of six analog channels. A very flexible data acquisition and processing system has been developed to allow both coherent and incoherent dual-polarization measurements to be performed; the system includes a microprocessor-controlled pulse-pair processor and a minicomputer with associated peripherals. The radar was operated successfully in Montana during the 1981 Cooperative Convective Precipitation Experiment. Preliminary results on the observed variation of the circular depolarization ratio demonstrate the usefulness of this sytem for monitoring the kinematics and microphysics of clouds and precipitation with good space and time resolution. (Baker-IVI)
W84-01854

SURVEY OF RADAR RAIN MEASUREMENT TECHNIQUES,
National Severe Storms Lab., Norman, OK.
R. J. Doviak.
Journal of Climate and Applied Meteorology, Vol. 22, No. 5, p 832-849, May, 1983. 10 Fig, 74 Ref.

Descriptors: *Rainfall, *Measuring instruments, Rain gage, Clouds, Storms, Estimating.

Several methods used to estimate rainfall rate R are surveyed. The distribution N(D) of drop sizes is of central importance in determining the reflectivity factor Z, attenuation rate K, and R. With single-parameter measurement techniques either of the remotely sensed parameters Z or K can be used to estimate R when gross assumptions on N(D) can be made. If N(D) can be described by a two-parameter distribution, dual measurement techniques can better estimate R without involving these coarse assumptions. A review is made of three techniques whereby two variables might be measured: 1) dual wavelength in which Z and K are remotely measured, 2) dual polarization in which reflectivity is measured with two orthogonal polarizations, and 3) raingage-radar combinations whereby in situ point measurements of R and radar measurement of Z or R are combined to obtain a better assessment of rain over areas between gages. It was concluded that there is still no satisfactory proven method in use to estimate rain rate or liquid water content accurately when high spatial and temporal resolution is needed. Dual-parameter measurement techniques appear to offer the best solution for rain rate estimation if N(D) is a significant error source and high resolution is reqired. There is need to evaluate the relative importance of error sources other than uncertainty in N(D) (Baker-IVI)
W84-01855

SPECIFICATION OF MONTHLY PRECIPITATION IN THE WESTERN UNITED STATES FROM MONTHLY MEAN CIRCULATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. C. Weare, and M. A. Hoeschele.
Journal of Climate and Applied Meteorology, Vol. 22, No. 6, p 1000-1007, June, 1983. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Rainfall, *Weather forecasting, Spatial distribution, Forecasting, California, Oregon, Washington.

The ability to specify monthly precipitation at 36 stations in Washington, Oregon and California by various indices of monthly mean circulation has been investigated. Most of the circulation indices were derived from eigenvector analyses of 700 mb geopotential heights or relative vorticity for 1951-76 or 300 mb relative vorticity for 1963-76. The results indicate that an average up to 60% of the rainfall variance may be specified by same-month average circulation parameters. The 700 mb parameters analyzed within a limited domain in the vicinity of the rainfall network result in the best specification ability. Indices derived from larger domains or from the 300 mb vorticities result in generally poorer specifications. Considerable spatial variation in specification ability is apparent with greatest skills evident in the coastal region of northern California and Oregon and lowest skills in the eastern regions of all three states. (Author's abstract)
W84-01856

HEAVY THUNDERSTORMS OBSERVED OVER LAND BY THE NIMBUS 7 SCANNING MULTICHANNEL MICROWAVE RADIOMETER,
Wisconsin Univ.-Madison. Space Science and Engineering Center.
R. W. Spencer, W. S. Olson, W. Rongzhang, D. W. Martin, and J. A. Weinman.
Journal of Climate and Applied Meteorology, Vol. 22, No. 6, p 1041-1046, June, 1983. 9 Fig, 23 Ref.

Descriptors: *Thunderstorms, *Satellite technology, *Weather forecasting, Rain, Radiometry, Clouds, Climate, Temperature effects.

In an examination of microwave data from the Nimbus 7 satellite, brightness temperatures were found that were much lower than those expected for the radiation emanating from rain-producing clouds. Even over land brightness temperatures much colder than those predicted from rain layer models occasionally are observed and in every case of cold brightness temperature heavy rain was observed at the surface. The cold temperatures can be explained if there is a thick layer of precipitation-sized ice hydrometeors above the rain. The same structure, presumably a wide, strong updraft, that allows a storm to carry precipitation well above the freezing level apparently also favors heavy rain. Thus it appears that the 37 GHz observations do at times contain information on relatively heavy rain rates. The coincidence of the coldest brightness temperatures with the most extreme weather events suggests as well that the 37 GHz channel may have some value in detecting severe local storms. (Baker-IVI)
W84-01857

PRECIPITATION IN SOUTHERN NEVADA,
Nevada Univ. System, Las Vegas. Water Resources Center.
R. H. French.
Journal of Hydraulic Engineering, Vol. 109, No. 7, July, 1983. 6 Fig, 8 Tab, 8 Ref. DOE contract DE-AC08-DPO-1253.

Descriptors: *Precipitation, *Nevada, Spatial distribution, Temporal distribution, Groundwater recharge, Flash floods.

The distribution of precipitation in both time and space in the southern Nevada area is examined. It is concluded that this area can be divided into two zones of precipitation separated by a transition zone on the basis of annual average precipitation. One region, relative to the other area, is define be a deficit annual average precipitation reg This observation could have a significant im on groundwater recharge estimates and on siting of facilities which must be protected f flash floods. In addition precipitation record two stations in the southern Nevada area v examined and point intensity/duration relat ships were derived for these stations. (Auth abstract)
W84-01965

LARGE FALLS OF RAIN IN WALES - SIMPLE STATISTICAL CASE STUDY,
I. T. Jolliffe.
Weather, Vol. 38, No. 4, p 103-106, April, 198 Tab, 1 Ref.

Descriptors: *Rainfall, *Statistical analysis, *F quency, Storms, Wales, Beacons Reservoir, Sw sea.

The possibility that an apparent increase in frequency of large rainfalls from the period 19 1980 as compared to the period prior to 1925 Wales may be due strictly to chance is investig ed. Three well known probability distributions nomial, Poisson, exponential) are used to determ the validity of this theory. The three techniq come to somewhat similar conclusions. For B cons Reservoir there is strong evidence that frequency of falls of rain of at least 2 or 3 in higher for the later parts of the data. The evide is less convincing for higher rainfalls (4 and 5 but this may be partly due to the small amounts data which are available. For Swansea, there is convincing evidence that the frequency of la rainfalls has changed during the period of obser tion. (Baker-IVI)
W84-01988

CIRCULATION TYPE AND THE SPATI DISTRIBUTION OF PRECIPITATION OV CENTRAL, EASTERN AND SOUTHERN EN LAND: PART II,
J. Stone.
Weather, Vol. 38, No. 7, p 200-205, July, 1983 Fig, 17 Ref.

Descriptors: *Weather patterns, *Precipitati *Atmospheric circulation, Spatial distributi England, Rainfall distribution.

A study was made of maps showing the mean da precipitation for the period 1961 to 1975 with t various cyclonic directional (or hybrid) types the Lamb catalogue. Indications were clear th the spatial variation of the mean daily precipitati varied a great deal with different circulation typ Proximity to low pressure, the curvature of t isobars and frontal activity are all important fa tors which help to explain these variations. Oth factors include the uplift afforded by relatively lo hills, sometimes no more than 50 meters high, a relative exposure to or shelter from moist win from the sea. Uplift and exposure are especial important when they operate in combination. Th can be seen in sourthern counties with both t straight isobar and cyclonic southerly and sout westerly types. On these occasions significant more precipitation fell inland over the low hi away from the coastal lowlands. This form intensification of precipitation also occurs in No folk when moist air streams blow inland off th North Sea. At the same time, however, ma southern and south-western areas are sheltered a receive less precipitation than Norfolk. Antic clonic types generally give light intensities. Certa areas received high daily precipitation from rel tively few circulation types. East Anglia for exa ple, received large falls mainly from the cyclon cyclonic north-westerly, straight isobar norther and cyclonic northerly types. (Baker-IVI)
W84-01989

RAINSHADOW - THE DYNAMICAL FACTO
Queen Mary Coll., London (England).
B. W. Atkinson.

ather, Vol. 38, No. 9, p 264-269, September, 3. 4 Fig, 9 Ref.

scriptors: *Rainfall distribution, *Weather pat-ns, *Rainshadow, Precipitation, England, les.

tribution of precipitation over a given area in a time is largely a function of the interplay ween airflow, cloud physics and topography. If effects of uniform frontal uplift and orography combined, one would expect a large precipita- area associated with the front within which vier precipitation would occur over hills. Con-sely, when presented with a precipitation map wing strong localization of precipitation over nd areas, it would be easy to conclude, though aps wrongly, that only orographical influences been operating. In considering such a case it omes clear that precipitation which occurred 29 July 1967 over England and Wales resulted n a combination of dynamical, orographical cloud-physical factors. As the frontal rain s moved north-eastward, a striking rainshadow ct appeared. This lack of precipitation to the of the Welsh hills was due largely to the amical factor rather than the orographical and d-physical factors. The case is an interesting inder that rainshadows are not always what seem to be. (Baker-IVI)
-01990

GNOSTIC STUDIES OF RAINFALL OMALIES IN NORTHEAST BRAZIL,
consin Univ.-Madison. Dept. of Meteorology.
Chu.
thly Weather Review, Vol. 111, No. 8, p 1655-, August, 1983. 12 Fig, 18 Ref.

criptors: *Rainfall, *Brazil, *Atmospheric cir-tion, Drought, Departure patterns, Rainy on, Dry season, Weather, Sea surface tempera-

large-scale atmospheric circulation of the il-Atlantic sector is studied in relation to ex-e rainfall anomalies in two large regions of heast Brazil (Nordeste). Long-term rainfall s, aerological records of stations in South rica, and ship observations over the tropical ntic form the data base for this study. Depar- patterns of meteorological elements over the ntic are investigated for composites of ex-ely dry and wet years in the southern and ern Nordeste. Southern Nordeste's peak rainy on is around November/December. The wet s in the southern Nordeste are marked by tive pressure departures over the South Atlan-veak onshore southeast trades and anomalous-ld waters along the south Brazil coast. These res appear to be related to Southern Hemi-ric frontal systems. During the dry years, de-re patterns are nearly reversed to those of the years. Northern Nordeste receives its maxi- rainfull in March/April. Rainfall variations nodulated by the latitudinal displacement of baric trough and confluence axis over the torial Atlantic and concomitant sea surface erature anomalies. Case studies of recent ex-e years indicate the possible existence of a meridional circulation. The more northerly ion of the convergence band over the Atlan-he anomalously cold waters to the south of the tor and the subsidence in the southern portion he thermally-induced meridional circulation over the Nordeste, characteristics of drought , are all unfavorable for rainfall in Northeast l. (Author's abstract)
-02040

-SAHARAN RAINFALL IN THE YEARS -80: EVIDENCE OF CONTINUED OUGHT,
Univ., Worcester, MA. Graduate School of graphy.
Nicholson.
thly Weather Review, Vol. 111, No. 8, p 1646-August, 1983. 7 Fig, 1 Tab, 20 Ref. NSF ATM-80-19009.

riptors: *Drought, *Rainfall, *Sub-saharan a, Africa, Biogeophysical feedback.

Rainfall is represented by a standarized annual departure calculated as the ratio of the annual departure to the standard departure. The departures for each of the five years are calculated for four semi-arid sub-Saharan zones (Sahelo-Sahara, Sahel, Soudan, Soudano-Guinean) and compared with values for the period 1901-75. Departures for regional subdivisions and individual stations are also derived. The analysis clearly shows that drought persisted in the region until at least 1980. Rainfall was well below normal in all four zones in 1976 and 1977. In most areas, deficits for these years were comparable to those of 1972 and 1973, the years of most extreme drought. Rainfall was below average in all years in nearly every region and for nearly every station. The persistence of extreme rainfall deficits throughout the 1970's may be a result of a biogeophysical feedback mechanism which promotes intense and persistent droughts. (Moore-IVI)
W84-02041

LINEAR ORGANIZATION OF LOCALIZED STORMS IN THE SUMMER RAINFALL ZONE OF SOUTH AFRICA,
Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
D. Sharon.
Monthly Weather Review, Vol. 111, No. 3, p 529-538, March, 1983. 10 Fig, 4 Tab, 13 Ref.

Descriptors: *Rainstorms, *South Africa, Spatial distribution, Rainfall distribution, Drought, Seasonal variation.

The spatial organization of localized showers in the summer rainfall region of South Africa has been studied by means of spatial correlation functions. A predominant linear arrangement of parallel shower belts has been identified, with an orientation between W-E and WNW-ESE. No differences were found in this respect between the driest years in the 1960's and the wettest ones in the 1950's and 1970's, but a linear trend was absent, or at least not prevalent at any fixed orientation, during the dry spell extending from the late 1940's to the early 1950's. The above linear trend has been found to persist also throughout the year, though, in general, rainfall appeared as spatially less organized during summer months than during spring and autumn. (Author's abstract)
W84-02043

RELATIONSHIP BETWEEN EASTERN EQUATORIAL PACIFIC SEA SURFACE TEMPERATURES AND RAINFALL OVER INDIA AND SRI LANKA,
National Weather Service, Washington, DC. Climate Analysis Center.
E. M. Rasmusson, and T. H. Carpenter.
Monthly Weather Review, Vol. 111, No. 3, p 517-528, March, 1983. 9 Fig, 6 Tab, 28 Ref.

Descriptors: *Rainfall, *Sea surface temperature, *India, *Sri Lanka, El Nino, Monsoons, Forecasting.

Monsoon season (June-September) precipitation data from 31 Indian subdivisions and mean monthly precipitation data from 35 Indian and Sri Lanka stations, spanning the period 1875-79, were analyzed to determine the relationship between equatorial Pacific warm episodes (El Nino events) and interannual fluctuations in precipitations over India and Sri Lanka. The data reveal a strong tendency for a below normal summer monsoon during the 25 moderate/strong warm episodes which occurred during the period. For example, area-averaged June-September rainfall over India was below the median value in 21 of the 25 warm episode years. These years include the five largest, and nine of the eleven largest, negative monsoon season anomalies. Considerably smaller average departures occurred during the monsoon seasons of the year preceding and the year following the warm episode, and during the remaining months of the warm episode year. The anomaly pattern over Sri Lanka and extreme southern India is quite different, the major feature being a period of above normal precipitation during the autumn of the warm episode year. During a typical warm episode, positive sea surface temperature anomalies appear along the Ecuador Peru coast early in the year, and thus precede the summer monsoon by several months. The forecasting implications of this relationship are discussed. (Author's abstract)
W84-02044

ONSET OF THE AUSTRALIAN MONSOON DURING WINTER MONEX: SYNOPTIC ASPECTS,
Australian Numerical Meteorology Research Centre, Melbourne.
N. E. Davidson, J. L. McBride, and B. J. McAvaney.
Monthly Weather Review, Vol. 111, No. 3, p 496-516, March, 1983. 10 Fig, 1 Tab, 23 Ref.

Descriptors: *Monsoons, *Australia, *Weather, Troposphere, Clouds, Satellite technology, Southern Hemisphere.

A case study is presented of the onset of the Southern Hemisphere summer monsoon at longitudes near Australia during December 1978. The numerical analyses comprising this case study are used in conjunction with station data and operational manually derived analyses for other years to investigate the following: 1) the ease of definition of monsoon onset; 2) the three-dimensional structure of the troposphere during an active monsoon situation; and 3) the flow changes preceding and during the transition from a period of suppressed to a period of enhanced cumulonimbus activity over tropical Australia. A well-defined onset occurs in six of the seven years considered. Onset, defined as a satellite-observed, large-scale increase in tropical convection, is consistent with that determined by the wind criterion of Troup (Indian J. Meteor. Geophys., 1961, 12, 217-230). In 1978 onset occurs in two stages: an increase in convergence, followed by an increase in convection. The monsoon cloudiness exists entirely in the region of low-level westerly wind. The convergence extends through a deep layer from the surface at 400 mb and exists in the upward branch of two linked Hadley cells, one from each of the Northern and Southern Hemispheres. Observations of the flow changes prior to onset lead to the hypothesis that the trigger mechanism lies in the Southern Hemisphere subtropics. It is conjectured that the seasonal buildup of planetary-scale land-sea temperature gradients has reached a critical stage such that the troposhere is in a state of readiness for the monsoon. Before the onset can take place, however, it must wait for the Southern Hemisphere midlatitude synoptic systems to be in such a configuration that low-level trade wind easterlies are prevalent across the Australian continent. The evidence is discussed also in favor of various alternative triggering mechanisms such as the influence of a Northern Hemisphere cold surge in the South China Sea and the westward propagation of equatorial westerlies from the Pacific Ocean near the international date line. (Author's abstract)
W84-02045

PHYSICAL BASIS FOR CHANGES IN THE PHASES OF THE SUMMER MONSOON OVER INDIA,
World Meteorological Organization, Baghdad (Iraq). Regional Training Center.
P. S. Pant.
Monthly Weather Review, Vol. 111, No. 3, p 487-495, March, 1983. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Monsoons, *Rainfall, *India, Weather, Meridional circulation, Mathematical models, Tibetan plateau, Eddy heat flux.

The summer monsoon over India is described as 'active' when large parts of India, particularly the central parts and the west coast receive normal or above normal rainfall. It is described as having a 'break' when the rainfall is below normal over most parts of India, except in the hills in the north and in the southeastern parts of the country. It is shown in this paper that when a break sets in, there is an in-situ formation of a zonally oriented trough at 10-15 degrees N at 700 mb over south India and

the adjoining seas. Simultaneously, there is a sharp fall in the 500 mb temperature over the Tibetan Plateau to much below normal values. As the plateau warms and attains near normal temperature, the trough in the south shifts northward and occupies the normal active monsoon trough position (around 20 degrees N) over north India. Considering the importance of meridional circulations in the tropics, it is reasonable to expect that the changes in the 700 mb flow with the phase changes are associated with corresponding changes in the meridional circulation. Computations of vertical motion along 75 degrees E with the help of quasi-geostrophic model show that under break monsoon conditions, the Hadley cell with its upward limb in the trough at 10-15 degrees N over south India and descent further north, predominates. Whereas, in the active monsoon phase, the monsoon cell, with a rising limb at about 20 degrees N and descent in the south, is prominent. The physical process through which the sudden cooling over the Tibetan Plateau brings about a change in the meridional circulation, and therefore a change in the phase of the monsoon from an active to a break situation, is explored through a quasi-geostrophic streamfunction for the meridional circulation. It is seen that eddy fluxes, particularly of heat, are one to two orders of magnitude larger at the northern end of the monsoon cell at the time of disruption of the monsoon. The vertical motions induced by these eddy fluxes are seen to be in the right direction to bring about a switch over from the monsoon cell to the Hadley cell. The re-establishment of the monsoon cell and with it the active phase appears to take place slowly through radiational heating over the Tibetan Plateau. (Author's abstract)
W84-02046

2C. Snow, Ice, and Frost

MELTWATER MOVEMENT IN A DEEP SNOWPACK; 1. FIELD OBSERVATIONS,
British Columbia Univ., Vancouver. Dept. of Geography.
P. Jordan.
Water Resources Research, Vol. 19, No. 4, p 971-978, August, 1983. 8 Fig, 22 Ref.

Descriptors: *Snowmelt, *Snowpack, *Flow, Unsaturated flow, Darcy's law, Conductivity, Capillary pressure, Hydrologic budget, Energy, Wave front, Hydraulic properites, Water content.

The flow of meltwater through a snowpack can be described by Darcy's law, and by a set of equations relating conductivity, capillary pressure, and liquid water content which are similar to the equations governing unsaturated groundwater flow. Field observations were conducted which were designed to test the applicability of the unsaturated flow equations to the description of meltwater movement at the scale of a small watershed. Simple instrumentation was used to measure capillary pressure and meltwater flux rates; this was supplemented with energy and water balance measurements for the study watershed. Observations of surface snowmelt, meltwater flux, and streamflow for the snowmelt period confirm the nature of meltwater flow as described by the unsaturated flow equations, and illustrate the controlling influence of snowpack hydraulics on the streamflow hydrograph. Observed speeds of the meltwater wave front in the snowpack average about 0.22 m/h, and capillary pressures and kinematic wave speeds observed are comparable to those reported in other deep-snow environments. The difficulty of obtaining reliable liquid water content measurements is identified as a major limitation in the determination of hydraulic properties of the snowpack. (Author's abstract)
W84-01890

MELTWATER MOVEMENT IN A DEEP SNOWPACK; 2. SIMULATION MODEL,
British Columbia Univ., Vancouver. Dept. of Geography.
P. Jordan.
Water Resources Research, Vol. 19, No. 4, p 979-985, August, 1983. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Snowmelt, *Snowpack, *Flow, Unsaturated flow, Mathematical models, Simulation, Energy, Hydraulic properties, Permeability coefficient, Conductivity, Capillary pressure, Water content.

A numerical simulation model is developed describing the one-dimensional flow of meltwater in a snowpack, based on established methods of modeling unsaturated groundwater flow. The results of field observations of snowmelt and meltwater flow are used to determine parameters describing the hydraulic properties of the snowpack, and surface energy balance measurements are used as input to the model. Tests of the performance of the model show a high sensitivity to the saturated hydraulic conductivity of the snowpack and to liquid water content of the snow. Saturated hydraulic conductivity can be measured with acceptable precision by simple field methods; however, measurement of liquid water content is more difficult and constitutes the major limitation affecting calibration of the model. The model is relatively insensitive to exponents in the power law equations relating conductivity, capillary pressure, and liquid water content. Meltwater wave speeds predicted by the model are somewhat slower than those observed in the field. Observations of snowpack layering and horizontal inhomogeneity of flow suggest that these features affect transient storage of meltwater and consequently cause meltwater wave speeds to differ from those predicted by a one-dimensional model. (Author's abstract)
W84-01891

HYDROMETEOROLOGICAL SIGNIFICANCE OF RIME ICE DEPOSITS IN THE COLORADO ROCKIES,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
E. E. Hindman, R. D. Borys, and P. J. DeMott.
Water Resources Bulletin, Vol. 19, No. 4, p 619-624, August, 1983. 3 Fig, 1 Tab, 24 Ref. NSF grant ATM 8109590.

Descriptors: *Rime ice, *Snowpack, *Mountains, Water content, Clouds, Snow, Rocky Mountains, Steamboat Springs, Colorado.

Observations and measurements were made during storm periods at mountain top sites in the Colorado Rockies during the winter of 1981-1982. On average, liquid clouds occurred with and without snowfall for, respectively, 75% and 15% of the observations. On average, the rime ice deposition rates were measured to be seven times the precipitation rates. The rime deposits were estimated to contribute 10% to the water content of the snowpack. Combining this figure with the estimated rime deposits on falling snow crystals (up to 50% by mass), up to 60% of the water content of the annual snowpack in the mountains near Steamboat Springs, Colorado, could be due to rime ice deposits. (Author's abstract)
W84-01948

2D. Evaporation and Transpiration

FREE AND FORCED CONVECTION EFFECT ON EVAPORATION,
Clemson Univ., SC. Dept. of Mathematics.
B. L. Sill.
Journal of Hydraulic Engineering, Vol. 109, No. 9, p 1216-1231, September, 1983. 7 Fig, 3 Tab, 18 Ref.

Descriptors: *Evaporation, *Surface water, Mathematical studies, Convection, Wind, Temperature effects, Mathematical equations.

The effects of free and forced convection mechanisms on evaporation from open water bodies is examined. Analogies between momentum, heat, and mass transfer from flat surfaces are employed to develop expressions for free and forced convective mass transport (evaporation). Use of these expressions with existing data sets from seven water bodies allows evaluation of the efficiencies of the two convection mechanisms. For the range of conditions studied here, forced convective transfer occurs at its theoretically predicted (or 100% efficient). However, the presence wind tends to disrupt free convective tra with the result that this mechanism becomes fective at high wind speeds or low values o face to air temperature difference. A new fo the Dalton type evaporation equation is also sented which is applicable over a wide ran conditions. (Baker-IVI)
W84-01967

2E. Streamflow and Runoff

TRANSVERSE MIXING IN WIDE AND SH LOW RIVER: CASE STUDY,
Rutgers - The State Univ., Piscataway, NJ. D of Civil and Environmental Engineering.
A. C. Demetracopoulos, and H. G. Stefan.
Journal of Environmental Engineering, Vol. No. 3, p 685-699, June, 1983. 6 Fig, 5 Tab, 22

Descriptors: *Mixing, *River flow, Mathema models, Thermal pollution, Cooling water, fluents, Nuclear powerplants, Tracers, Transv mixing, Mississippi River.

A method has been proposed for the computa of the transverse mixing coefficient in wide shallow rivers. The effluent from a side cha heated discharge was used as a tracer in this st A modified method of moments was developed the computation of transverse mixing coefficie Modifications were introduced to account tracer loss by a first order process; and for vari ity of stream cross sections. The method is gen and permits use of effluent site data without a tional instream experimentation. An applicatio the technique to the Monticello Nuclear Po Generating Plant cooling water outfall on upper Mississippi River yielded an average dim sionless transverse mixing coefficient with a ra from 0.24-4.65. This average is similar to that ported for other streams, and about one orde magnitude larger than the values derived fr laboratory experiments. (Moore-IVI)
W84-01773

FLOW IN ALLUVIAL-RIVER CURVES,
Universidad Central de Venezuela, Caracas. Fac tad de Ingenieria.
M. F. Ascanio, and J. F. Kennedy.
Journal of Fluid Mechanics, Vol. 133, p 1- August, 1983. 8 Fig, 15 Ref.

Descriptors: *Fluid mechanics, *Channels, *Al vial rivers, Rivers, Shear stress, Fluctuations.

Uniform flow in curved, wide, erodible-bed ch nels is formulated on the basis of the conservat of flux of moment-of-momentum, to obtain re tions for the vertical distributions of radial-pla velocity and radial shear stress. The expression the radial stress exerted on the bed is utilized i force-equilibrium analysis of the moving bed la to obtain relations for the average transverse slo of the bed and for the radial bed profile. T reduction of primary bed shear stress due to net radial transport of streamwise momentu toward the outer (concave) bank is then calculate by introducing the derived expressions for t velocity components into the momentum equati for the primary-flow direction. It is found that t stress reductions in deep, narrow channels c exceed 50%. Bed profiles and velocity distrib tions measured in natural and laboratory strea are found to be in good conformity with tho calculated from this moment-bases theory. (A thor's abstract)
W84-01851

CALCULATION OF SORPTIVITY FROM CO STANT-RATE RAINFALL INFILTRATIO MEASUREMENT,
Southern Illinois Univ. at Carbondale. Dept. Forestry.
For primary bibliographic entry see Field 2C
W84-01863

LTWATER MOVEMENT IN A DEEP
)WPACK; 1. FIELD OBSERVATIONS,
sh Columbia Univ., Vancouver. Dept. of Ge-
phy.
primary bibliographic entry see Field 2C.
-01890

LTWATER MOVEMENT IN A DEEP
)WPACK; 2. SIMULATION MODEL,
sh Columbia Univ., Vancouver. Dept. of Ge-
phy.
primary bibliographic entry see Field 2C.
-01891

IABILITY OF THE DESIGN STORM CON-
T IN EVALUATING RUNOFF PEAK
W,
e Polytechnique, Montreal (Quebec). Dept. of
Engineering.
audoin, J. Rousselle, and G. Marchi.
r Resources Bulletin, Vol. 19, No. 3, p 483-
June, 1983. 4 Fig, 10 Ref. Quebec Ministry of
ation grant CRP-356-75, IBM of Canada
CR-3065-80.

riptors: *Flood peak, *Runoff rate, *Comput-
odels, Design storms, Rainfall-runoff relation-
, Soil water, Rainfall intensity, Rainfall dura-
Rainfall frequency, Montreal, Quebec.

mparative study was undertaken to evaluate
runoff flow rates using (1) a continuous series
tual rainfall events and (2) design storms. The
JDAS computer model was used to simulate
f over a catchment within the city of Montre-
anada. A ten-year period, five-minute incre-
rainfall data base was used to derive peak
frequency curves. Two types of design storms
analyzed: one derived from intensity duration
ency curves (Chicago type), the other from
ging actual rainfall patterns (Huff type). An-
ent soil moisture conditions were considered
e analyses. It was found that the probability
bution of runoff peak flow was sensitive to
hoice of design storm pattern and to the
edent soil moisture condition. A symmetrical,
go-type design storm with antecedent dry
noisture produced a flow frequency curve
r to the one obtained from a series of histori-
infall events. (Author's abstract)
01935

LINEAR RUNOFF MODELING: PARAM-
R IDENTIFICATION,
rnia Univ., Davis. Dept. of Civil Engineer-
Patry, and M. A. Marino.
al of Hydraulic Engineering, Vol. 109, No. 6,
-880, June, 1983. 10 Fig, 5 Tab, 25 Ref. CSRS
ct CA-D*-LAW-4254-H.

riptors: *Rainfall-runoff relationships, *Math-
cal models, Urban watersheds, Simulation,
ographs, Quebec, Montreal, Curotte-Papin-

nlinear functional rainfall-runoff model is ap-
to an urban watershed (Curotte-Papineau,
real) and the results are compared with those
the ILLUDAS model. Simulations are per-
d using a 5 minute time interval in order to
define the characteristics of the hydro-
s. Particular emphasis is placed on the identi-
on of the most appropriate set of model pa-
ers, namely the memory of the catchment (U)
he order of expansion of the first-order and
d-order kernels M1 and M2. Parameter iden-
ion based on calibration results alone can
o unpredictable verification (prediction) re-
while calibration results improve with in-
ng values of M1 and M2, verification results
t exhibit the same consistency. Consequently,
-way calibration-verification analysis is rec-
ended for obtaining the best set of model
eters. Further, results of the nonlinear func-
runoff model compare favorably with those
ILLUDAS model. (Author's abstract)
01961

REALISTIC ASSESSMENT OF MAXIMUM FLOOD POTENTIALS,
D. W. Newton.
Journal of Hydraulic Engingeering, Vol. 109, No. 6, p 905-918, June, 1983. 6 Fig, 13 Ref.

Descriptors: *Probable maximum flood, *Probability, *Dam design, Dam evaluation, Design floods, Rainfall distribution, Storms, Headwaters, Flood hydrographs, Climate, Tennessee Valley.

A procedure is proposed which uses probability concepts to achieve a consistent realistic assessment of the probable maximum flood (PMF) and its use in design or evaluation of high-hazard dams. A PMF computation involves selection of a sequence of meteorologic and hydrologic events. These include the principal storm, antecedent and/or subsequent storms, time and areal distribution of rainfall, loss rates, and the hydrograph determination. Computed maximum headwater levels used in dam design or evaluation depend on assumed initial reservoir levels, operating conditions, and windwave conditions. A review of present practice shows basic agreement on events or conditions to postulate, but signficant differences in their magnitude. These differences produce major variations in the relative magnitude of computed flood. Further, some events are defined in terms which, when applied in different climatic regions, will result in computed floods of varying relative magnitude. The results of studies conducted by Tennessee Valley Authority to establish a consistent and realistic standard for PMF determination in the Tennessee Valley region are used to illustrate the proposed procedures. (Author's abstract)
W84-01962

FLOW DEPTH IN SAND-BED CHANNELS,
Tetra Tech, Inc., Pasadena, CA.
For primary bibliographic entry see Field 8B.
W84-01963

MAIN FLOW VELOCITY IN SHORT RIVER BENDS,
Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W84-01964

FLOOD PLAIN AND MAIN CHANNEL FLOW INTERACTION,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W84-01966

A RESIDUAL NOISE MODEL FOR STREAMFLOW PREDICTION,
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
L. A. Logan, W. C. Lennox, and T. E. Unny.
Canadian Journal of Civil Engineering, Vol. 10, No. 3, p 437-449, 1983. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Streamflow, *Prediction, Forecasting, Model studies, Residual noise, Hydrologic models.

A nonlinear, conceptual hydrologic model is formulated for use in predicting flows under conditions of controlled input. The model has time invariant parameters and a residual noise model is incorporated for sequential prediction of hourly flows using a closed loop feedback scheme with hypothetically controlled inputs which are adapted to the residuals. The residual model derived comprises error terms which are correlated in time and variable. This implication was resolved from the fact that more effective improvement in prediction was attained in cases where the hydrologic model residual autocorrelations appear to be correlated. The suitability of the model to predict flows at different times at a site involving data not included as part of the calibration and with suboptimal basic model parameters is demonstrated. This residual noise and adapted input control adjustment approach will be useful in simple test applications for contingency plans on control of reservoir releases during storm events, or as a means of providing a measure for flood mitigation at damage centers. (Baker-IVI)
W84-01983

DYNAMIC MODEL FOR THE OVERLAND FLOW ON AN INFILTRATING CATCHMENT,
Helsinki Univ. of Technology, Espoo (Finland). Systems Theory Lab.
K. Pingoud.
Applied Mathematical Modelling, Vol. 7, No. 2, p 128-134, April, 1983. 7 Fig, 21 Ref.

Descriptors: *Surface runoff, *Overland flow, *Infiltration, Mathematical models, Rainfall-runoff relationships, Catchment areas, Simulation.

An approximate lumped parameter model for the surface runoff phenomenon on a catchment is presented. It consists of two submodels which are spatial discretizations of the basic partial differential equations of overland flow and infiltration. The aim of the model is to describe the dynamical input-output relationship between the rainfall rate and the surface runoff from the catchment. The boundary conditions of the infiltration process are modelled in an approximate way so that the number of state variables in the model can be reduced. With the aid of a single model parameter it is possible to describe simple catchment shapes like linearly converging and diverging surfaces. The model structure is flexible so that it can also be applied to more complex catchment configurations. The simulation results show that the phenomenon under consideration can be properly described by the model structure presented. (Moore-IVI)
W84-01994

FLOODS: AUSTRALIA'S AWFUL VISITATIONS,
Bureau of Meteorology, Melbourne (Australia).
J. F. Elliott.
Weatherwise, Vol. 36, No. 3, p 114-117, June, 1983. 2 Fig.

Descriptors: *Floods, *Australia, Flood control, Cyclones, Rainfall, Flood damage, Monsoons, Urban areas, Flood forecasting.

Floods are a major problem in Australia with almost every area of the continent subject to this type of devastation. Floods are particularly severe in their effects when they occur near major population centers and areas of intense agriculture which are often found on lower river valleys and plains. The inland rivers of northern New South Wales drain very productive agricultural areas and a number of provincial cities are sited on their flood plains. The area is subject to frequent flooding and despite various measures taken to mitigate their effects, floods continue to be a problem. Cyclonic and monsoonal rain are the major causes of flooding in the country. Flash floods are also a problem, but not as severe a problem as in the United States. Flood forecasting and warning services, coupled with a range of emergency service and counter disaster activities have been developed to varying degrees in most areas. Land use controls and planning measures are also being adopted. (Baker-IVI)
W84-01998

2F. Groundwater

DETERMINATION OF BULK ROCK PROPERTIES FROM GROUND-WATER LEVEL FLUCTUATIONS,
Texas A and M Univ., College Station. Dept. of Geology.
P. A. Domenico.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 3, p 283-287, 1983. 1 Tab, 16 Ref.

Descriptors: *Water level fluctuations, *Stress analysis, *Groundwater, Mathematical studies, Stress, Stress-strain curves, Stress analysis, Water level, Water table.

Ideas from stress-strain theory have been redeveloped in order to relate water level fluctuations to the bulk elastic properties of the last rock. The detailed constitutive relations for isothermal porous mediums are briefly restated. The response of ground-water levels to tides and changes in barometric pressure provides an in-situ measure of the response of the rock-water system to changes in stress. Tidal and barometric efficiencies can thus be expressed in terms of drained and undrained moduli. In addition, if the various moduli are known from laboratory measurements, the laboratory equivalents of both tidal and barometric efficiency can provide an estimate of the specific storage. The method is demonstrated to provide reasonable and consistent results when applied to various rock types of differing rigidity including clay, sandstones, limestone and basalt. (Baker-IVI)
W84-01813

IN-SITU DETERMINATION OF SOIL HYDRAULIC PROPERTIES DURING DRAINAGE,
Alabama Agricultural Experiment Station, Auburn.
J. H. Dane, and S. Hruska.
Soil Science Society of America Journal, Vol. 47, No. 4, p 619-623, July-August, 1983. 7 Fig, 19 Ref.

Descriptors: *Soil water, *Permeability coefficient, *Drainage, Boundary conditions, Soil water retention.

In-situ soil water retention and hydraulic conductivity relations were determined for two soils from knowledge of initial and boundary conditions and water content profiles during drainage. Empirical relations were assumed for each soil between volumetric water content (theta) and soil water pressure head (h), and between hydraulic conductivity (K) and theta. Assigning values to the parameters in these relations made it possible to solve the general water flow equation for the same initial and boundary conditions as encountered in the drainage experiments. Calculated water content profiles were compared with measured water content profiles at corresponding times. Differences in measured and calculated theta values provided information for changes to be made in the parameters. This procedure was repeated until a satisfactory agreement was found and the determined relations apparently represented the soils in question. (Author's abstract)
W84-01862

MATHEMATICAL MODEL FOR REGIONAL LAND SUBSIDENCE DUE TO PUMPING; 3. INTEGRATED EQUATIONS FOR A PHREATIC AQUIFER,
Delaware Univ., Newark. Dept. of Civil Engineering.
M. Y. Corapcioglu, and J. Bear.
Water Resources Research, Vol. 19, No. 4, p 895-908, August, 1983. 10 Fig. 16 Ref. Engineering Foundation grant RC-A-79-1A.

Descriptors: *Subsidence, *Pumping, *Drawdown, *Horizontal displacement, Aquifers, Mathematical models, Water table fluctuations, Groundwater surface, Confined aquifers, Stress.

A mathematical model is developed for the areal distribution of drawdown, land subsidence, and horizontal displacements due to groundwater pumping from a deformable phreatic aquifer. Following the development of a three-dimensional mathematical model consisting of a mass conservation equation, quasi-static equilibrium equations, and stress-strain relations for an assumed perfectly elastic solid matrix, a regional, horizontal two-dimensional model is derived by averaging the three-dimensional model over the vertical thickness of the aquifer, taking into account the continuous variation in total stress as a result of water table fluctuations. The separation of an initially coinciding phreatic surface, which serves as the upper boundary of the aquifer, and a surface consisting of a set of solid particles during the lowering of the water table and the compaction of the aquifer has been incorporated into the averaging procedure. The analytical solution for the case of a single pumping well, which is expressed in terms of the classical well function for a confined aquifer but with a modified storativity, provides estimates of drawdown, vertical subsidence, and horizontal displacements. The displacements for a sample problem are compared with those of a confined aquifer under similar conditions. Under the conditions of the studied case of radial flow, vertical and horizontal displacements due to pumping from a phreatic aquifer with the same discharge rate would be less than those of a confined one. The same averaging procedure is extended for a system of phreatic and leaky confined aquifers and for the unsaturated zone above the water table. An additional change in total stress is obtained in terms of moisture content of the zone above the phreatic surface. (Moore-IVI)
W84-01883

AQUIFER THERMAL ENERGY STORAGE: AN ATTEMPT TO COUNTER FREE THERMAL CONVECTION,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W84-01885

LABORATORY INVESTIGATIONS OF STEAM FLOW IN A POROUS MEDIUM,
W. N. Herkelrath, A. F. Moench, and C. F. O'Neil, II.
Water Resources Research, Vol. 19, No. 4, p 931-937, August, 1983. 6 Fig, 1 Tab, 17 Ref, 1 Append.

Descriptors: *Steam flow, *Geothermal studies, *Pressure, Sand, Silt, Clay, Porous media, Adsorption, Simulation, Mathematical models, Radioactive wastes.

Transient, superheated steam flow experiments were run by bringing a cylinder of porous material to a uniform initial pressure and then making a step increase in pressure at one end of the sample while monitoring the pressure transient breakthrough at the other end. At 100 degrees, 125 degrees, and 146 degrees C, the time required for steam pressure transients to propagate through an unconsolidated material containing sand, silt, and clay was 10-25 times longer than predicted by conventional superheated steam flow theory. The delay in the steam pressure transient may be caused by adsorption of steam in the porous sample. In order to account for steam adsorption, a sink term was included in the conservation of mass equation. Energy transfer in the system has to be considered because latent heat is released when steam adsorption occurs, increasing the sample temperature by as much as 10 degrees C. The steam pressure was a function of both the temperature and the amount of adsorption in the sample. This function was assumed to be an equilibrium adsorption isotherm, which was determined by experiment. By solving the modified mass and energy equations numerically, subject to the empirical adsorption isotherm relationship, excellent theoretical simulation of the experiments was achieved. Quantitative understanding of the physics of the flow of steam in porous media is important in modeling fluid transport in geothermal systems and in high-level nuclear waste repositories. (Moore-IVI)
W84-01886

THEORETICAL EXPLANATION OF SOLUTE DISPERSION IN SATURATED POROUS MEDIA AT THE DARCY SCALE,
Indiana Univ. at Bloomington. Dept. of Mathematics.
R. N. Bhattacharya, and V. K. Gupta.
Water Resources Research, Vol. 19, No. 4, p 938-944, August, 1983. 1 Fig, 18 Ref. NSF grants CME-8004498 and CME-8004499.

Descriptors: *Porous media, *Solute transport, *Dispersion, Peclet number, Convection, Probability, Darcy scale.

The transport of a nonreactive dilute solute in saturated porous media is explained at three distinct space-time scales. These are the kinetic, microscopic, and Darcy scales. The transition from one scale to the next higher scale, i.e., from the kinetic to the microscopic to the Darcy, is a consequence of the central limit theorem of probability theory. At the microscopic scale, the solid and the liquid phases together form a heterogeneous continuum. The microscopic solute concentration is governed by a parabolic equation with spatially varying drift and diffusion coefficients. The so-called dispersion phenomenon at the Darcy scale is shown to appear in the transition from the microscopic to the Darcy scale. In the computation of the dispersion coefficients, the Peclet number appears naturally as a dimensionless parameter. For large Peclet numbers the coefficients of dispersion at the Darcy scale are shown to be linear in the liquid convective velocity. A general expression is obtained which gives the order of magnitude of the dispersion coefficient for all Peclet numbers within the Darcy regime of the liquid convective velocities. This expression shows that for very small Peclet numbers, only the molecular diffusion provides the dominant contribution, whereas for intermediate values of Peclet numbers, both the liquid convection and the molecular diffusion contribute to the dispersion coefficients; in this range the dispersion coefficients are not linear in the liquid convective velocity. These findings are well supported by existing experimental observations. These theoretical insights into dispersion at the Darcy scale are also important in explaining the so-called macrodispersion and the scale effect at field scales. (Author's abstract)
W84-01887

STEADY STATE FLUID RESPONSE IN FRACTURED ROCK: A BOUNDARY ELEMENT SOLUTION FOR A COUPLED, DISCRETE FRACTURE CONTINUUM MODEL,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering.
A. M. Shapiro, and J. Andersson.
Water Resources Research, Vol. 19, No. 4, p 959-969, August, 1983. 10 Fig, 19 Ref.

Descriptors: *Fractures, *Groundwater movement, *Aquifers, Mathematical models, Geohydrology, Porous media.

A discrete fracture representation of a highly fractured groundwater aquifer is inappropriate as a modeling approach since the location of all fractures can never be explicitly specified. However, the alternative of exclusively employing a continuum description of the medium then neglects any geologic information that exists with regard to the location of specific fractures in such formations. In order to take better advantage of geologic information in highly fractured aquifers a model is proposed which couples the discrete fracture and continuum conceptualizations. In regions where discrete fractures are designated, an efficient means of computing the steady state fluid responses is formulated with the use of the boundary element method. This allows the consideration of highly complex fracture geometries, since fluid responses in the porous rock are described with a set of linear equations written only in terms of the hydraulic head and fluid mass flux at the boundaries the porous rock shares with the fractures. One-dimensional equations of fluid movement in the fractures written in terms of the same variables make coupling of the two systems straight forward. In this technique, discretization only along the fractures is required. Thus the internal discretization of the host rock that would be characteristic in the use of finite difference and finite element methods is alleviated. At the boundary of the region where specific fractures are identified, a continuum conceptualization is coupled to the discrete fracture model. Steady state fluid responses in the continuum domain are defined using a semianalytic technique which is based on the discretization of Green's third identity. The resulting coupled model allows the discrete fracture and continuum conceptualizations to be employed in the modeling of those areas where they are judged to be most appropriate, based on the availability of physical information. (Author's abstract)
W84-01889

LIBRARY U. OF I. URBANA-CHAMPAIGN

BILITY ANALYSIS OF WATER MOVE-T IN UNSATURATED POROUS MATERI-2. NUMERICAL STUDIES,
South Wales Univ., Kensington (Australia). ol of Civil Engineering.
Diment, and K. K. Watson.
r Resources Research, Vol. 19, No. 4, p 1002-August, 1983. 9 Fig, 5 Tab, 17 Ref.

riptors: *Hydrodynamics, *Soil water, Stabili-nalysis, Computer models, Mathematical ls, Unsaturated flow, Infiltration, Porous .

odynamic stability analysis is applied to the ty of several soil water systems some of are potentially unstable. The first stage in alysis requires the generation of water con-nd pressure head profiles using a computer-numerical solution for the flow equation for rated porous materials. These profiles permit lculation of certain differential terms which r in the specification of the coefficients re-l in the stability analysis. Results for growth f imposed disturbances of wavelengths of 1, 25 cm together with the appropriate eigen-rs are presented for infiltration into a homo-us profile, redistribution following infiltra-nfiltration into a scale hetergeneous medium, nfiltration into a fine-over-coarse stratified e. Although instability was expected for the ribution, heterogeneous, and layered systems, esults, while showing a noticeable trend d instability, did not predict the occurrence h a condition. All the analyses have been d out with initial water contents of 0.05 cu cm. Small amounts of initial water can have ificant effect on the damping-out of instabil-hat otherwise would occur under dry initial ions. (Moore-IVI)
01893

E ELEMENT TECHNIQUES FOR MOD-G GROUNDWATER FLOW IN FRAC-D AQUIFERS,
rans, Inc., Reston, VA.
Huyakorn, B. H. Lester, and C. R. Faust.
Resources Research, Vol. 19, No. 4, p 1019-August, 1983. 17 Fig, 5 Tab, 29 Ref. DOE ct E512-02900.

iptors: *Groundwater movement, *Geologic es, Mathematical models, Simulation, s media, Aquifers, Confined aquifers, Hy-c gradients.

lternative conceptual models of groundwat-v in fractured aquifers are considered. The ree are based on the dual-porosity approach ifferent representations of fluid interactions en the fractures and porous matrix blocks, e fourth is based on the discrete fracture ch. Two numerical solution techniques are ted for solving the governing equations asso-with the dual-porosity flow models. In the chnique the Galerkin finite element method to approximate the equation of flow in the e domain and a convolution integral is used cribe the leakage flux between the fractures rous matrix blocks. In the second the Galer-ite element approximation is used in con-n with a one-dimensional finite difference imation to handle flow in the fractures and blocks, respectively. Both numerical tech-are readily amendable to the governing ns of the discrete fracture flow model. To the proposed numerical tecniques and com-arious conceptual models, four simulations roblem involving flow to a well fully pene-a fractured confined aquifer were per-l. Each simulation corresponded to one of r conceptual models. For the three simulat-es, where analytical solutions are available, merical and the analytical solutions were red. Both solution techniques yielded good with relative coarse spatial and temporal izations. Greater accuracy was achieved by mbined finite element-convolution integral que for early time values at which steep lic gradients occurring near the fracture-interface could not be accommodated by near finite difference approximation. For cases involving transient simulation of leakage from the matrix blocks to fractures, greater accuracy was achieved by the combined finite element-convolution technique. The combined finite element-convolution technique should be used in preference to the combined finite element-finite difference technique if greater accuracy is required in the early time simulation. (Moore-IVI)
W84-01895

DEVELOPMENT OF REACTION MODELS FOR GROUND-WATER SYSTEMS,
Geological Survey, Reston, VA.
L. N. Plummer, D. L. Parkhurst, and D. C. Thorstenson.
Geochimica et Cosmochimica Acta, Vol. 47, No. 4, p 665-686, April, 1983. 3 Fig, 9 Tab, 46 Ref.

Descriptors: *Geochemistry, *Groundwater, *Reaction models, Thermodynamics, Mass balance, Simulation, Reaction paths, Dolomite, Carbon isotopes, Sulfur isotopes, Gypsum, Ferric hydroxide, Pyrite, Carbon dioxide, Organic carbon, Florida.

Methods are described for developing geochemical reaction models from the observed chemical compositions of ground water along a hydrologic flow path. The roles of thermodynamic speciation programs, mass balance calculations, and reaction-path simulations in developing and testing reaction models are contrasted. Electron transfer is included in the mass balance equations to properly account for redox reactions in ground water. The mass balance calculations determine net mass transfer models which must be checked against the thermodynamic calculations of speciation and reaction-path programs. Although reaction-path simulations of ground-water chemistry are thermodynamically valid, they must be checked against the net mass transfer defined by the mass balance calculations. An example is given testing multiple reaction hypotheses along a flow path in the Floridan aquifer where several reaction models are eliminated. Use of carbon and sulfur isotopic data with mass balance calculations indicates a net reaction of incongruent dissolution of dolomite (dolomite dissolution with calcite precipitation) driven irreversibly by gypsum dissolution, accompanied by minor sulfate reduction, ferric hydroxide dissolution, and pyrite precipitation in central Florida. Along the flow path, the aquifer appears to be open to CO2 initially, and open to organic carbon at more distant points down gradient. (Author's abstract)
W84-01984

SANDSTONE WATER SENSITIVITY: EXISTENCE OF A CRITICAL RATE OF SALINITY DECREASE FOR PARTICLE CAPTURE,
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
K. C. Khilar, H. S. Fogler, and J. S. Ahluwalia.
Chemical Engineering Science, Vol. 38, No. 5, p 789-800, 1983. 15 Fig, 3 Tab, 10 Ref. NSF grants NSF-G-ENG79-06647, NSF CPE 8108197.

Descriptors: *Sandstones, *Salinity, *Permeability, Clay, Water sensitivity, Groundwater movement, Particle capture, Clogging, Pores, Mathematical models, Berea sandstone.

A critical rate of salinity decrease (CRSD) was found to exist in the water sensitivity of Berea sandstone. The CRSD was determined by conducting core flood experiments in which the salinity was decreased exponentially by placing mixers of various volumes in the inlet stream. The CRSD is equal to a space velocity of 0.40/hr at a superficial velocity of 25.6 cm/hr. The superficial velocity has a significant effects on the CRSD. At a velocity of 2.4 cm/hr, the CRSD is equal to a space velocity of 0.10/hr. The CRSD decreases with decreasing velocity. Above the CRSD, drastic reductions in core permeability occur due to a log jam, or bridging effect, at the pore constriction. Below the CRSD, the released clay particles pass through the constriction without being captured and therefore very little reduction in core permeability occurs. A critical particle concentration was also identified above which bridging occurs. A mathematical model developed to delineate the regions of high and low permeability reductions was found to be in good agreement with experimental measurements. (Moore-IVI)
W84-01992

COMMON COMPOSITION CHARACTERISTICS OF FLUORIDE BEARING GROUNDWATERS,
Andhra Univ., Waltair (India). Dept. of Geophysics.
V. V. J. Sarma, and A. N. Swamy.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 29-39, July 1983. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Groundwater, *Fluoride, Visakhapatnam basin, India, Calcium, Magnesium, Sodium, Sodium carbonate, Alkalinity.

During routine groundwater surveys of the Visakhapatnam basin, concentrations of fluoride ions above the permissible limit of 1 to 1.5 mg/l were detected near the village of Jaggayyapalem in Andhra Pradesh State, India. The fluoride bearing groundwaters of the area were compared with fluoride bearing groundwaters from different parts of the world. In general, there exists a good linear negative relationship between F(-) and Ca(2+) plus Mg(2+) ions, and a linear positive relationship between F(-) and HC03(-) ions in high fluoride bearing groundwater. Most of the fluoride bearing waters contain high to very high amounts of Na and are classified as high to very high alkali hazard waters. Almost all the waters contain very high amounts of residual sodium carbonate, exceeding the maximum value of 2.5 meq/l. (Moore-IVI)
W84-02124

2G. Water In Soils

ASSESSING THE SUITABILITY OF SOILS WITH MACROPORES FOR SUBSURFACE LIQUID WASTE DISPOSAL,
Stichting voor Bodemkartering, Wageningen (Netherlands).
For primary bibliographic entry see Field 5D.
W84-01805

PASSIVE MICROWAVE SENSING OF SOIL MOISTURE CONTENT: THE EFFECTS OF SOIL BULK DENSITY AND SURFACE ROUGHNESS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. R. Wang.
Remote Sensing of Environment, Vol. 13, No. 4, p 329-344, September, 1983. 8 Fig, 1 Tab, 25 Ref.

Descriptors: *Soil water, *Radiometry, *Measuring instruments, Soil density, Physical properties, Remote sensing.

Microwave radiometric measurements over bare fields of different surface roughness were made at frequencies of 1.4 GHz, 5 GHz, and 10.7 GHz to study the frequency dependence, as well as the possible time variation, of surface roughness. An increase in surface roughness was found to increase the brightness temperature of soils and reduce the slope of regression between brightness temperature and soil mositure content. The frequency dependence of the surface roughness effect was relatively weak when compared with that of the vegetation effect. Radiometric time-series observations over a given field indicate that field surface roughness might gradually diminish with time, especially after a rainfall or irrigation. The variation of surface roughness increases the uncertainty of remote soil moisture estimates by microwave radiometry. Three years of radiometric measurements over a test site revealed a possible inconsistency in the soil bulk density determination, which is an important factor in the interpretation of radiometric data. (Author's abstract)
W84-01852

LIBRARY U. OF I. URBANA-CHAMPAIGN

CALCULATION OF SORPTIVITY FROM CONSTANT-RATE RAINFALL INFILTRATION MEASUREMENT,
Southern Illinois Univ. at Carbondale. Dept. of Forestry.
S.-K. Chong.
Soil Science Society of America Journal, Vol. 47, No. 4, p 627-630, July-August, 1983. 3 Fig, 21 Ref.

Descriptors: *Ponding, *Rainfall infiltration, *Sorptivity, Rainfall-runoff relationships, Permeability coefficient, Soil hydraulics, Hawaii.

Incipient ponding time equations were rearranged and used for calculating sorptivity under constant-rate rainfall conditions. The equations were tested using the field-measured data obtained in Hawaii. The incipient ponding time is assumed equal to the time of first appearance of runoff from the experimental plot. Additionally, the A value in the Philip two-term infiltration equation is assumed to be Ksat/3. The sorptivity values calculated from both equations have only a 1.22% difference. The accuracy of the calculated sorptivity was assessed by its use for predicting infiltration. In the comparison of cumulative infiltration, the correlation coefficient between measured and estimated values is > 0.9 with a mean error percentage of 20.09 and a median of 10.57%. The equation requires information on rainfall intensity, saturated hydraulic conductivity, and the incipient ponding time. Even though the time to incipient ponding and the time of first appearance of runoff were different, the assumption that they are equal is acceptable for runoff plots within uniform slopes. Using rainfall infiltration to measure sorptivity is impractical since the experiment requires tremendous time and labor. It is possible to calculate sorptivity from the simulated rainfall-runoff experiment. (Moore-IVI)
W84-01863

SOIL WATER DIFFUSIVITY NEAR SATURATION,
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
B. E. Clothier, and R. A. Wooding.
Soil Science Society of America Journal, Vol. 47, No. 4, p 636-640, July-August, 1983. 6 Fig, 18 Ref.

Descriptors: *Soil water, *Diffusivity, *Soil saturation, *Water retention, Moisture tension, Permeability coefficient, Soil absorption capacity.

Many laboratory porous materials are considered to have a zone of tension-saturation in their water retentivity curve near saturation, which implies that the soil water diffusivity, D, is infinite in such a region. Three new methods of measuring the diffusivity near saturation are presented. The soil used in all experiments was the fine sand-textured C horizon of Manawatu fine sandy loam, a Dystric Fluventic Eutrochrept. All methods found D to be finite, yet large, having a value of approximately 0.001 to 0.002 sq m/s. Since the near-saturated conductivity of the sand is of the order 10 to the -5 m/s this implies that the water retentivity curve near saturation has a finite but large slope of order 100 m. This was compatible with the measured retentivity data. The theory of one-dimensional absorption implies that the slope of the Boltzmann variable with respect to volumetric water content near saturation equals twice D divided by the sorptivity. The slope calculated this way was compatible with that found in absorption experiments. (Moore-IVI)
W84-01864

EFFECT OF SYNTHETIC CONDITIONERS ON SOIL WATER RETENTION, HYDRAULIC CONDUCTIVITY, POROSITY AND AGGREGATION,
American Univ., Beirut (Lebanon). Dept. of Soils, Irrigation and Mechanization.
For primary bibliographic entry see Field 3F.
W84-01865

EFFECT OF SLOPE ON WATER BALANCE UNDER CENTER-PIVOT IRRIGATION,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
A. Y. Hanna, P. W. Harlan, and D. T. Lewis.
Soil Science Society of America Journal, Vol. 47, p 760-764, July-August, 1983. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Soil water, *Slope, *Center-pivot irrigation, Water storage, Water balance, Surface runoff, Soil infiltration, Evapotranspiration, Corn, Sprinkler irrigation, Soil drainage, Rainfall-runoff relationships, Nebraska, Gage County.

The effects of slope on water storage and other water balance components under center-pivot irrigation were studied in Gage County, Nebraska. Soil water, surface runoff, precipitation, and irrigation were measured for soils of low infiltration on slopes of 2, 4, and 8% under corn (Zea mays L.). Evapotranspiration was calculated. Soil water content (0- to 137-cm depth) during the growing season was higher in soils on 8% slopes than in soils on slopes of 2 and 4%. Runoff from all slopes was not associated with sprinkler irrigation in the crop production system studied. As slope increased, surface runoff caused by rain increased, and internal drainage beyond the 137-cm depth decreased at approximately the same rate. The overall water depletion during the growing season was not significantly affected by slope. (Author's abstract)
W84-01868

MODELS FOR ESTIMATING IN-SITU POTENTIAL EXTRACTABLE WATER USING SOIL PHYSICAL AND CHEMICAL PROPERTIES,
Texas Agricultural Experiment Station, College Station.
D. K. Cassel, L. F. Ratliff, and J. T. Ritchie.
Soil Science Society of America Journal, Vol. 47, No. 4, p 764-769, 1983. 2 Fig, 4 Tab, 15 Ref.

Descriptors: *Soil properties, *Moisture availability, Soil water, Physical properties, Chemical properties, Model studies, Estimating.

Accurate evaluation of the upper and lower limits of soil water availability is vital for accurate computation of the water balance in marginally dry regions. Empirical equations were developed for calculation of the limits of in situ potential extractable soil water using routinely measured soil proerties. Physical and chemical properties were determined on samples collected from depth increments coinciding with measurements of extractable water limits. The potential extractable water calculated as the difference between the upper and lower limits based upon the equations developed was correlated with measured plant extractable water for the different levels of input information and textural separations. The coefficients of determination for potential extractable water ranged from 0.375 for the two-variable input level with no textural separation to 0.758 for the 10-input level with three textural separations. Standard deviation for the latter, best correlated system to estimate potential extractable water was about 2 percentage units when compared with field measured extractable water. (Baker-IVI)
W84-01869

FIELD-MEASURED LIMITS OF SOIL WATER AVAILABILITY AS RELATED TO LABORATORY-MEASURED PROPERTIES,
Texas Agricultural Experiment Station, College Station.
L. F. Ratliff, J. T. Ritchie, and D. K. Cassel.
Soil Science Society of America Journal, Vol. 47, No. 4, p 770-775, July-August, 1983. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Soil water, *Water availability, Crops, Water supply, Soil properties.

The accurate evaluation of soil water reserves available for plant use is vital in developing optimum water management for crop production in marginally dry regions. A comprehensive data base of field measured upper and lower limits of soil water reservoir was obtained and evaluated. The field measured upper limit was taken as the water content at which drainage from a prewetted soil had practically ceased. The lower limit was taken as the water content of the soil at which plants were practically dead or dormant as a result of the soil water deficit. Variation often exist within a soil series at a particular site for the fi measured upper and lower limits. However, differences between the field-measured limits, total available water reservoir, were relative constant. Crop species caused only minor diff ences in the lower limit water content for upper part of the soil profile where root leng density was apparently above some critical lev However, some annuals extracted water to grea depths than others. If absolute accuracy is nec sary in water balance calculations, laboratory e mated soil water limits should be used with caut and field measured limits would be preferre (Baker-IVI)
W84-01870

WATER BUDGET OF AN EASTERN DECIDUOUS FOREST STAND,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2I.
W84-01871

CHARACTERIZING UNSATURATED HYDRAULIC CONDUCTIVITY OF WESTERN KENTUCKY SURFACE MINE SPOILS AND SOILS,
Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
A. Ward, L. G. Wells, and R. E. Phillips.
Soil Science Society of America Journal, Vol. 47, No. 5, p 847-855, September-October, 1983. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Permeability coefficient, *Soil infiltration, *Spoil banks, *Mine wastes, *Strip mine wastes, Mathematical models, Soil water, Soil saturation.

A large-scale laboratory infiltrometer system was used to determine infiltration characteristics of 'reconstructed' surface mine spoil and soil horizons. Soil water characteristic curves were determined using the Brooks-Corey and the Gardner procedures and developed based on desorption tensiometer data. Unsaturated hydraulic conductivity values were determined using the 'plane of zero flux' procedure and compared with predictions resulting from models described by Campbell, Burdine, and Mualem for situations involving reconstructed soil and spoil materials. There was generally good agreement between the models and excellent agreement between Campbell's predictions and plane of zero flux results. Both the Gardner equation and the Brooks-Corey equation gave good estimates of the soil water characteristic curves for the materials. The physical significance of the parameters Theta sub r, and Psi sub e when determined by statistical procedures, appears very questionable. In this study, the final steady-state infiltration rate appeared to be a good estimate of the hydraulic conductivity at apparent saturation. (Author's abstract)
W84-01872

PULSED TRICKLING EFFECTS ON SOIL MOISTURE DISTRIBUTION,
Illinois Univ. at Urbana-Champaign.
For primary bibliographic entry see Field 3F.
W84-01946

2H. Lakes

LAKE TEMPERATURE DYNAMICS IN HYBRID COOLING SYSTEM,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
T. W. Sturm, J. M. Fulford, and K. J. Fay.
Journal of Environmental Engineering, Vol. 109, No. 3, p 668-684, June, 1983. 10 Fig, 24 Ref. NSF grant ENG78-21957.

Descriptors: *Cooling lakes, *Simulation, *Thermal properties, Thermal pollution, Solar heating, Cooling water, Wind, Advection, Diffusion, Water temperature, Thermal stratification, Water circulation, Epilimnion, Indiana.

nsient thermal simulation model of a hybrid
ng lake is developed to assess the impact of
ng water withdrawals and cooling tower dis-
es on the thermal structure of the lake. The
l is based on one-dimensional mechanical and
al energy balances and includes the physical
sses of solar heating, wind stirring, vertical
tion, and hypolimnetic diffusion. Tempera-
data were collected on two small lakes in
ern Indiana, and the simulated temperatures
mpared with the measured data for the lake
fication seasons of 1976 and 1978. Cooling
circulations significantly thicken the epilim-
due to vertical advection of heat. This is
rmed by the observed variation of three di-
onless parameters which characterize the es-
l physical processes that affect the lake ther-
tructure. These parameters are a wind Rich-
n number, a withdrawal densimetric Froude
er, and a dimensionless surface buoyancy
The simulation model can be used to quantify
ermal response of the lake due to a change in
ithdrawal densimetric Froude number while
ther two dimensionless parameters remain
nged. (Moore-IVI)
01772

**DSAT IMAGERY FOR ASSESSING
NGES IN LAKE AREAS AT DUNGENESS,
HE KENT COAST,**
eating.
al of the Institution of Water Engineers and
tists, Vol. 37, No. 4, p 290-294, August, 1983.
, 1 Tab.

riptors: *Lakes, *LANDSAT, *Satellite tech-
y, Hydrogeology, Dungeness, England,
ote sensing.

ydrogeology of the Dungeness shingle beach
ng studied. The beach is the major source of
eting aggregate in southeast England, and
l extraction below the water table has led to
evelopment of lakes. The growth of the lakes
een monitored using conventional aerial pho-
phy and images from the LANDSAT earth
rces satellite. The areas of the three major
as deduced from the LANDSAT images are
n along with the total open water area on the
. The aerial surveys of the beach were under-
on July 18, 1972, June 19, 1977 and October
981 at scales of 1:22,000, 1:75000 and 1:5000,
ctively. The open water areas have been de-
l from these aerial photographs manually.
1978 LANDSAT data and aerial survey data
or dates only 60 days apart, which provides a
ure of the accuracy of the LANDSAT data.
two estimates of total open water area differ
ly 5%. The aerial survey data are also given.
all, these figures show that the second lake
ined relatively unchanged over the 10 year
d, while the other lakes have undergone con-
able changes. The development of one lake as
ced from the LANDSAT data is shown.
er-IVI)
01818

**T FILLING OF KIELDER RESERVOIR
FUTURE OPERATIONAL CONSIDER-
ONS,**
primary bibliographic entry see Field 4A.
01819

**RIENT RETENTION AND TRANSFOR-
ION IN RELATION TO HYDRAULIC
SHING RATE IN A SMALL IMPOUND-
NT,**
Ridge National Lab., TN. Environmental Sci-
s Div.
Turner, E. A. Laws, and R. C. Harris.
nwater Biology, Vol. 13, No. 2, p 113-127,
, 1983. 3 Fig, 9 Tab, 50 Ref.

riptors: *Impoundments, *Nutrients, Cycling
ents, Silicates, Phosphates, Phytoplankton,
uctivity, Population dynamics, Lake Talquin,
da.

fluxes of water, chloride, silicate and various
s of nitrogen and phosphorus into and out of a 3925 ha impoundment (Lake Talquin) in north Florida were examined over a 3 year period. Annual hydraulic flushing rates for the lake varied by a factor of more than 2 during the study period and provided an opportunity to examine the effect of flushing rate on nutrient cycling within the lake. The results support the hypothesis that nutrient retention and transformation in lakes and impoundments with high flushing rates (>1/year) are appreciably influenced by annual variations in flushing rates. Higher fractions of input silicate and total phosphorus were retained by Lake Talquin during the years with average flushing rates (8/year) than during a year with abnormally high flushing rate (16/year). Nitrogen was not appreciably retained during any of the three study years, and thus N:P ratios in the lake outflow were higher than in the inflow. Phytoplankton productivity was appreciably higher (70%) during the year with the higher flushing rate, apparently in response to higher reactive phosphorus concentrations in the lake and perhaps to a higher standing crop of phytoplankton during that year. Reactive phosphorus and dissolved inorganic nitrogen inputs could account for only about 30% and 25%, respectively, of the phosphorus and nitrogen required to support observed photosynthetic rates in all three study years. Recycling of nutrients apparently accounted for most of the remainder, although nitrogen fixation could not be ruled out as a factor in the nitrogen budget. (Author's abstract)
W84-01831

INFLUENCE OF ELEVATED NITRATE CONCENTRATION ON RATE OF LEAF DECOMPOSITION IN A STREAM,
Georgia Univ., Athens. Dept. of Zoology.
J. L. Meyer, and C. Johnson.
Freshwater Biology, Vol. 13, No. 2, p 177-183, April, 1983. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Organic matter, *Litter, *Decomposition, Forest watersheds, Nutrients, Streams, Nitrates, Phosphorus, Nitrogen, Environmental effects, Ecosystems.

Leaf decomposition was compared in two streams at the Coweeta Hydrologic Laboratory, North Carolina. One stream drains an undistributed hardwood watershed, while the other drains a successional watershed subject to an insect outbreak. The successional watershed has elevated nitrate concentrations in the streamwater. Both black locust (Robinia pseudo-acacia) and sweet birch (Betula lenta) leaf litter decomposed 2.8 times more rapidly in the stream with high nitrate concentrations. The more rapid decay rates appeared to be partly due to accelerated microbial processing in response to nitrate enrichment, because microbial biomass (as ATP) was higher in the nitrate-enriched stream. At each point in time, nitrogen and phosphorus content of the litter was lower in the high nitrate stream; however, there was no significant difference in nitrogen or phosphorus content at the same state of leaf decay in the two streams. Natural watershed disturbances such as insect infestations or anthropogenic disturbances such as clear cutting, by increasing the nitrate content of stream water, can alter rates of detrital processing in streams. In a detritus-based ecosystem a change in detrital processing rates could profoundly affect stream ecosystem function. (Baker-IVI)
W84-01832

CONTINUOUS AMMONIUM ENRICHMENT OF A WOODLAND STREAM: UPTAKE KINETICS, LEAF DECOMPOSITION, AND NITRIFICATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. D. Newbold, J. W. Elwood, M. S. Schulze, R. W. Stark, and J. C. Barmeier.
Freshwater Biology, Vol. 13, No. 2, p 193-204, April, 1983. 6 Fig, 4 Tab, 36 Ref.

Descriptors: *Streams, *Sediments, *Ammonium, *Enrichment, Nitrification, Nitrogen, Adsorption, Benthic environment, Nitrates, Tennessee, Walker Branch.

In order to test for nitrogen limitation and examine ammonium uptake by stream sediments, ammonium hydroxide was added continuously at concentrations averaging 100 micrograms/liter for 70 days to a second-order reach of Walker Branch, an undisturbed woodland stream in Tennessee. Ammonium uptake during the first 4 hr of addition corresponded to adsorption kinetics rather than to first-order uptake or to Michaelis-Menten kinetics. However, the calculated adsorption partition coefficient was two to four orders of magnitude greater than values reported for physical adsorption of ammonium, suggesting that the uptake was largely biotic. Mass balance indicated that the uptake of ammonium from the water could be accounted for by increased nitrogen content in benthic organic detritus. Nitrification, inferred from longitudinal gradients in NO3, began soon after enrichment and increased dramatically near the end of the experiment. Both ammonium and nitrate concentrations dropped quickly to near background levels when input ceased, indicating little desorption or nitrification of excess nitrogen stored in the reach. There was no evidence of nitrogen limitation as measured by weight loss, oxygen consumption, phosphorus content, and macroinvertebrate density of red oak leaf packs, or by chlorophyll content and aufwuchs biomass on plexiglass slides. A continuous phosphorus enrichment 1 year earlier had demonstrated phosphorus limitation in Walker Branch. (Author's abstract)
W84-01833

PHOSPHORUS AND CALCIUM CARBONATE SOLUBILITIES IN LAKE KINNERET,
Technion - Israel Inst. of Tech., Haifa.
Y. Avnimelech.
Limnology and Oceanography, Vol. 28, No. 4, p 640-645, July, 1983. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Lakes, *Chemical properties, Algal growth, Phosphates, Calcium, Nutrients, Lake Kinneret, Calcium carbonate.

Phosphate and calcium carbonate solubilities were calculated from data obtained for near-bottom water samples from Lake Kinneret during the years 1975-1977. A potential diagram technique was used to determine which solid phase is in equilibrium with the solution. Both phosphorus and calcium carbonate solubilities are controlled, during the January-August period, through equilibrium with calcium-carbonate-phosphate. The calcium carbonate ionic product changes, depending on the phosphoric acid potential, during this period. Calcium carbonate activity is constant during the last months of the stratified period (September-December). These findings support the hypothesis that the first and most reactive product of the reactions occurring between calcium carbonate and phosphorus is a CaCO3H3PO4 surface complex. (Baker-IVI)
W84-01836

EFFECTS OF REGULATION OF THE RIVER TEES UPON FISH POPULATIONS BELOW COW GREEN RESERVOIR,
D. T. Crisp, R. H. K. Mann, and P. R. Cubby.
Journal of Applied Ecology, Vol. 20, No. 2, p 371-386, August, 1983. 4 Fig, 13 Tab, 13 Ref.

Descriptors: *Fish populations, *Reservoirs, *Environmental effects, Seasonal variation, Population density, Green reservoir, River Tees.

The population density, growth, biomass, fecundity and production of bullhead (Cottus gobio) and brown trout (Salmo trutta) were estimated in the River Tees below the regulating reservoir at Cow Green. Comparisons were made with estimates obtained for the same site before impoundment, and with data from Maize Beck, and unregulated tributary of the Tees below the reservoir. Changes in the growth of trout were negligible, but there was an apparent decrease in the observed lengths of O group bullheads in the regulated Tees. This may reflect a shorter growing season because bullheads spawned later in the Tees after impoundment, possibly in response to the delay in the increase in water temperature during the spring. There were marked annual variations in the numbers of brown trout and bullhead, but population

densities of both species increased in the Tees following regulation. The numbers of both species were significantly higher in the Tees than in Maize Beck during both periods. The annual instantaneous mortality rate of bullheads increased from 0.67 to 1.30 in the Tees following impoundment; corresponding values for Maize Beck were 0.68 and 0.81. The mean fecundity of individual female bullheads of any given size decreased in the Tees, but remained the same in Maize Beck. The increase in population density in the Tees caused a significant increase in the number of eggs laid each year by the whole population from 3.70 to 8.42 eggs/sq m. The corresponding values in Maize Beck of 2.04 and 2.28 eggs/sq m were not significantly different. Only very approximate values were obtained for annual production of trout. Estimated bullhead production increased slightly at Maize Beck and by a factor of three in the Tees. Annual production by older fish changed little. The combination of environmental changes caused by regulation has improved conditions for the downstream fish populations. This has been exploited by the bullheads and trout mainly through increased population density and population biomass, rather than through any marked increased in the growth rate of individual fish. This would be expected because growth rate appears to be limited mainly by water temperature. (Baker-IVI)
W84-01837

FISH OF CHANNELIZED AND UNCHANNELIZED SECTIONS OF THE BUNYIP RIVER, VICTORIA,
James Cook Univ. of North Queensland, Townsville (Australia). School of Biological Sciences.
K. G. Hortle, and P. S. Lake.
Australian Journal of Marine and Freshwater Research, Vol. 34, No. 3, p 441-450, 1983. 1 Fig, 6 Tab, 26 Ref.

Descriptors: *Fish population, *Channeling, *Environmental effects, Rivers, Streams, Population density, Bunyip River, Australia.

The distribution and abundance of fish at three channelized and three unchannelized sites on the Bunyip River in southern Victoria were investigated. Ten species of native fish, including the Australian grayling (Prototroctes maraena), and two species of introduced fish were collected in three sets of seasonal samples by electrofishing. The unchannelized sites and a channelized site directly above a small weir had significantly higher species richness, total fish biomass, numerical density and standing crop than the other two channelized sites. Ammocoete lamprey larvae, short-finned eels, southern pigmy perch and brown trout were most abundant at the unchannelized sites, whereas the common jollytail was most abundant at the channelized sites. Total numbers and biomass of fish and species richness were all positively correlated with the area of snags present, and species richness and fish biomass correlated positively with the area of slack water. It appears that the absence of suitable habitat (viz, area of snags, area of slack water, length of bank fringed with vegetation) accounts for the lower abundance and lower species richness of fish after channelization. A small weir at one of the channelized sites ameliorated partly the effects of channelization. (Author's abstract)
W84-01839

EARLY EUTROPHICATION IN THE LOWER GREAT LAKES: NEW EVIDENCE FROM BIOGENIC SILICA IN SEDIMENTS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske, E. F. Stoermer, D. J. Conley, J. A. Robbins, and R. M. Glover.
Science, Vol. 222, No. 4621, p 320-322, October, 1983. 2 Fig, 1 Tab, 27 Ref.

Descriptors: *Eutrophication, *Lakes, Diatoms, Sedimentation, Nutrients, Great Lakes, Lake Ontario, Lake Erie, Lake Michigan.

New evidence from studies of biogenic silica and diatoms in sediment cores related to eutrophication in the lower Great Lakes is presented. Diatom production peaked from 1820 to 1850 in Lake Ontario, at about 1880 in Lake Erie, but not until 1970 in Lake Michigan. The biogenic silica data from Lake Michigan and Lake Ontario cores indicate that the silica-depletion sequence occurred over a relatively short period of time, possibly as little as 20 to 40 years. This short time course shows that silica dynamics and mass-balance relations can be affected significantly and rapidly by biological effects of nutrient enrichment. Silica-limited steady states have developed in Lake Ontario and Lake Erie and possibly since 1970 in Lake Michigan. Lake Huron with recent increases in BSI storage may be in a transition between steady states whereas silica dynamics have been affected least in Lake Superior where phosphorus enrichment has been least. (Baker-IVI)
W84-01840

FISH COMMUNITIES ALONG ENVIRONMENTAL GRADIENTS IN A SYSTEM OF TROPICAL STREAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
P. L. Angermeier, and J. R. Karr.
Environmental Biology of Fishes, Vol. 9, No. 2, p 117-135, September, 1983. 10 Fig, 6 Tab, 46 Ref.

Descriptors: *Forests, *Streams, *Fish populations, Rainfall, Topography, Benthic environment, Behavior, Nutrients, Tropical regions, Panama, Trophic level.

Fish community structure was examined in 9 forested streams (1-6 m wide) in central Panama during dry seasons over a 3 year period. Study regions varied in annual rainfall, degree of canopy shading, and topographical relief. Benthic invertebrates were more abundant in riffles than in pools and more abundant in eary (January) than late (March) dry season. In addition, benthos abundances were negatively correlated with canopy shading among study regions. Terrestrial invertebrate abundances were greater in January than March and were correlated with stream width. Fishes were assigned to 7 feeding guilds (algivores, aquatic insectivores, general insectivores, piscivores, scale-eaters, terrestrial herbivores, omnivores) on the basis of similarity of gut contents. Four species exhibited marked dietary shifts with increasing size. Distributions of feeding guilds (biomass) among habitats and streams were not generally correlated with availabilities of their major food resources. All feeding guilds except aquatic insectivores were most concentrated (biomass per area) into deep pools. Densities of algivores and terrestrial herbivores increased with stream size, but the density of aquatic insectivores declined. Species richness of feeding guilds increased with stream size and canopy openness. The proportion of fish biomass supported by algae and terrestrial plant material increased with stream size, while that supported by aquatic and terrestrial invertebrates declined. Small fishes (< 40 mm TL) were most abundant in pools of small streams. Terrestrial predators appeared to be more important than food availability in determining distributions of fish among habitats. However, trophic diversity of fish communities may be related to the reliability of available food resources. (Author's abstract)
W84-01842

LEAF PROCESSING IN TWO CONTRASTING BEECH FOREST STREAMS: EFFECTS OF PHYSICAL AND BIOTIC FACTORS ON LITTER BREAKDOWN,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
J. S. Rounick, and M. J. Winterbourn.
Archiv fur Hydrobiologie, Vol. 96, No. 1, p 448-474, April, 1983. 8 Fig, 4 Tab, 53 Ref.

Descriptors: *Organic matter, *Streams, *Litter, Forests, Forest watersheds, Biodegradation, New Zealand.

Changes in dry weight, protein and oxygen consumption of mountain beech leaves held in mesh bags in two New Zealand streams were investigated and interpreted in relation to the contrasting physical and faunal chacteristics of the streams. Weight losses were most rapid in coarse-mesh (5 mm) bags incubated in Middle Bush Stream, a relatively stable stream with a large population of shredders. In contrast, leaf breakdown rate in coarse-mesh bags held in Craigieburn Cutt Stream, a more unstable stream with few shredd was similar to that recorded in fine mesh (0.2 m containers in both streams. Leaves in bags bur in the beds of both streams lost weight m slowly than their surface counterparts and h slightly lower protein levels and respiration ra Larvae of the caddisfly, Zelandopsyche ingi were primarily responsible for the rapid disappe ance of beech leaves in Middle Bush Stream. A though apparently absent from Craigieburn C ting Stream, cage experiments showed that larv grew and survived equally well in both strea Absence of Z. ingens from Craigieburn Cutti Stream is attributed to the inability of the stream retain coarse particulate organic inputs. Retenti appears to be the key to shredder abundance a hence a major factor controlling litter breakdow In streams with poor retention capacities, the c ganic layers which develop on stone surfaces a the most important sites of carbon transfer to t benthos. (Baker-IVI)
W84-01844

ENERGY FLOW, TROPHIC EVOLUTION AN ECOSYSTEM MANAGEMENT OF A KASH MIR HIMALAYAN LAKE,
Central Inland Fisheries Research Inst., Harwa (India).
K. K. Vass, and D. P. Zutshi.
Archiv fur Hydrobiologie, Vol. 97, No. 1, p 39-5 May, 1983. 2 Fig, 5 Tab, 70 Ref.

Descriptors: *Phytoplankton, *Lakes, *Ecosys tems, Productivity, Zooplankton, Photosynthesis Kashmir, Dal Lake.

Dal Lake is situated in an urban environment an thus exposed to undesirable human influence which threaten its existence. The efficiency o energy utilization at various trophic levels of th lake has been studied. In Dal Lake ecosystem it ha been observed that through photosynthesis th system fixes about 1009 g out of which only 11% i contributed by phytoplankton and 88% by macro phytes. Periphyton accounts for less than 1% o primary production. Respiratory losses are quite high and on a yearly basis it comes to 69%. Zoo plankton fix about 0.41 g carbon/sq m/yr while fish harvest amounts to 0.165 g carbon/sq m/yr and 312.7 g carbon/sq m/yr are returned back to lake bottom. The conversion efficiency between primary producers and zooplankton is 0.17% and between former and fish it is 0.019%. Benthic population of the lake is insignificant. Thus most of the energy fixed by macrophytes is unutilized. In order to make good use of this component, introduction of grass carp is desirable. (Baker-IVI)
W84-01847

LIGHT INTENSITY AND RELATIVE LIGHT CHANGES AS FACTORS REGULATING STREAM DRIFT,
New Hampshire Univ., Durham. Dept. of Zoology.
J. F. Haney, T. R. Beaulieu, R. P. Berry, D. P. Mason, and C. R. Miner.
Archiv fur Hydrobiologie, Vol. 97, No. 1, p 73-88, May, 1983. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Light intensity, *Mayflies, Behavior, Daphnia, Population dynamics, Behavior, Drift.

Studies were conducted in two woodland streams to evaluate the importance of light intensity and relative rate of light change on the timing and density of mayfly drift. Under natural conditions light intensity ranged from 1.0-12.9 micro W/sq cm and relative light change from -.0024 to -.0036/sec at the time of the initiation of evening drift (EDI). When light intensity was reduced 85% by covering a section of the stream, light intensity at EDI was also lower and the timing of drift shifted, despite little difference in the relative light change. A model of light control of evening drift is proposed that involves the interaction of photokinetic

ity regulated by the relative change in light
hototactic behavior controlled by light inten-
The effect of moonlight on the pattern of drift
ared to be related to the relative rate of
ge in moonlight, rather than its absolute inten-
A model of light control of EDI is proposed
h includes a photokinetic activity regulated
ne relative light change and a phototactic
vior controlled by light intensity. An empiri-
near regression model was developed using
esults of the study to predict the time of
tion of drift based on light intensity and time
e relative light change threshold. (Baker-IVI)
01848

**ERPRETATION OF PHOSPHORUS LOAD-
S IN DYSTROPHIC LAKES,**
lale Coll., Mississauga (Ontario).
ow-Fraser, and H. C. Duthie.
iv fur Hydrobiologie, Vol. 97, No. 1, p 109-
May, 1983. 2 Fig, 3 Tab, 45 Ref.

riptors: *Dystrophic lakes, *Phosphorus,
el studies, Biomass, Chlorophyll, Canadian
d, Phytoplankton.

ication of the model sequence of Vollen-
er (1969) and Dillon and Rigler (1974) relating
horus loading to phytoplankton biomass was
tigated on a basin of a dystrophic Canadian
d Lake. A phosphorus budget was estimated
field measurements, and was subsequently
to predict the spring P concentration (P-spr).
bserved (P-spr) was then employed to predict
nean summer (chlor-a). Comparisons were
between these predicted values and observed
entrations. Results of these comparisons indi-
that whereas the P-budget could accurately
ct (P-spr) grossly over-estimated (chlor-a).
implies that the use of P-loading models for
ning permissible and critical loadings may not
to dystrophic systems and that alternate
ods should be investigated. While total phos-
us measurements are useful in year-to-year
arisons of the same lake in similar lake types,
etion is advised in making lake-to-lake ex-
lations. (Baker-IVI)
01849

**E OF SUSPENDED SEDIMENTS IN THE
RITION OF ZOOPLANKTON IN TURBID
ERVOIRS,**
as State Univ., Manhattan. Div. of Biology.
Arruda, G. R. Marzolf, and R. T. Faulk.
ogy, Vol. 64, No. 5, p 1225-1235, October,
7 Fig, 4 Tab, 65 Ref.

riptors: *Zooplankton, *Reservoirs, *Turbidi-
rganic matter, Adsorption, Aquatic life, Nu-
s, Daphnia.

rvoirs built on rivers draining agricultural wa-
eds are often turbid with suspended sedi-
s. Filter-feeding zooplankton, e.g., members
e genus Daphnia, seem to be as abundant in
reservoirs as in natural lakes. Using con-
d laboratory conditions, the potential role of
ended sediments in the nutrition of Daphnia
a turbid reservoir was investigated. In three
of experimental procedures measurements
made of: (1) the physical effect of sediments
ne ingestion and incorporation rates of algae
aphnids, (2) the ingestion rates of two sizes of
mineral sediment particles by daphnids, and
ne growth and survival of daphnids fed yeast
sediments with and without organic matter
rbed onto the particle surfaces. Increases in
ended sediment concentration from 0.0 to 2451
L decreased ingestion rates of 14C-labeled
rella vulgaris by Daphnia parvula and D.
x by about 95% and decreased incorporation
by 99%. Sediment concentrations of 50-100
L reduced the algal carbon ingested by daph-
to potential starvation levels. 65Zn-labeled
and coarse (1.88 and 4.65 micrometer mean
eter) clay mineral sediment particles were fed
. parvula, D, pulex, and D. similis. Ingestion
of sediments by daphnids were limted at
cle concentrations of about 5000000 particles/
and were dependent on particle size, daphnid
ies, and body size. Fine particles were ingested at greater rates by D. pulex and D. parvula than were coarse particles, while large D. similis ingested coarse and fine particles at similar rates. In addition, D. pulex had higher ingestion rates in each particle size suspension than did D. parvula or D. similis. The differential ability to ingest these particles suggests a mechanism of regulating daphnid species composition if the organic matter adsorbed to these sediment particles is useful as food. To evaluate this mechanism, dissolved organic protein was adsorbed to sediment particles. When D. pulex were fed the amended sediment suspension, they grew larger than when fed control sediments, but not as large as when fed yeast. D. parvula grew equally well when fed either yeast or amended sediments. Thus, dissolved organic matter can be made available for daphnic growth by the mechanism of adsorption. (Baker-IVI)
W84-01850

A METHOD FOR THE REDUCTION OF LAKE MODEL PREDICTION ERROR,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow.
Water Research, Vol. 17, No. 8, p 911-916, August, 1983. 1 Fig, 11 Ref.

Descriptors: *Lakes, *Error analysis, *Water quality, *Model studies, Water quality control, Phosphorus, Land use.

Recent work on methods of error analysis to accompany the application of lake models has not enjoyed great acceptance in part because of the magnitude of the error term. For the models that have undergone a rigorous error analysis, prediction errors for various water quality variables are often 30% or more. A procedure is proposed for the reduction of the error associated with the prediction of lake phosphorus concentration from land use and hydrologic data. Existing lake quality data are used in the prediction, and the model is employed only to project changes from the present state. This obviates the need to project all land use impacts with the model. Only those proposed to change are projected. The result is a substantial reduction in prediction error for many planning scenarios. (Baker-IVI)
W84-01903

EFFECT OF ACIDIFICATION, METALS AND METALLOIDS ON SEDIMENT MICROORGANISMS,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W84-01904

DYNAMIC BACTERIAL MODEL FOR A RECREATIONAL LAKE,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W84-01943

LIGHT-PRODUCTIVITY MODEL FOR ONONDAGA LAKE, N.Y.,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
S. D. Field, and S. W. Effler.
Journal of Environmental Engineering, Vol. 109, No, 4, p 830-844, August, 1983. 6 Fig, 1 Tab, 35 Ref.

Descriptors: *Primary productivity, *Light, New York, Onondaga Lake, Hypereutrophic lakes, Mathematical models, Photosynthesis, Water temperature, Chlorophyll a, Nutrients, Light attenuation, Seasonal variation, Quantum yield.

Two models were calibrated to the 1978 primary productivity conditions of nutrient-rich hypereutrophic Onodaga Lake, N.Y.; one was based on the approach of Bannister (Limnology and Oceanography, Vol. 19, 1974, p 1-12), the other on a more conventional format. The data base, necessary for model development, included continuously monitored incident photosynthetically active radiation (PAR), and 115 parallel measurements of water column temperature, PAR attenuation, chlorophyll a, primary productivity, and key nutrients. Values of key parameters for the Bannister model, obtained by evaluation of the data set, differed from those recommended in the literature. Both models effectively predicted seasonal and short-term trends in primary productivity for most of the study, though the Bannister model was slightly better. The Bannister model predictions were particularly sensitive to estimates of the maximum quantum yield of photosynthesis. The Bannister model is preferred on theoretical grounds, since it incorporates more fundamental and more constant parameters, and more properly accounts for temperature influences. (Author's abstract)
W84-01954

PRIMARY PRODUCTIVITY IN A LARGE, TEMPERATE LAKE WITH RIVER INTERFLOW: KOOTENAY LAKE, BRITISH COLUMBIA,
National Water Research Inst., Vancouver (British Columbia).
S. Jasper, E. C. Carmack, R. J. Daley, C. B. J. Gray, and C. H. Pharo.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 3, p 319-327, March, 1983. 8 Fig, 1 Tab, 34 Ref.

Descriptors: *Phytoplankton, *Productivity, *Kootenay Lake, British Columbia, Chlorophyll, Water temperature, Photosynthesis, Euphotic zone, Light, Nutrients, River inflow, Stratification.

Phytoplankton productivity in a large, deep lake with river interflow was determined using an incubator method modified to include vertical distributions of chlorophyll and temperature together with continuous surface irradiance measurements. The annual average areal production, in 1977, was 170 g C/sq m with daily areal productions ranging from 100 to 2800 mg C/sq m. P max for all samples correlated well with chlorophyll a ($r=0.79$). No large horizontal trends in areal productivity or Pmax were found in the lake at any time of the year. However, pronounced differences with depth in the photosynthetic characteristics of populations within the euphotic zone were common during the stratified season. The two large inflowing rivers are thought to be important to the productivity of Kootenay Lake as they initiate the spring production peak and supply nutrients to the deeper phytoplankton populations during the summer and fall period.
W84-01972

EFFECTS OF CHANGES IN PH ON TRANSPARENCY AND THERMAL REGIMES OF LOHI LAKE, NEAR SUDBURY, ONTARIO,
Ontario Ministry of the Environment, Rexdale. Limnology and Taxonomy Section.
N. D. Yan.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 5, p 621-626, May, 1983. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Hydrogen ion concentration, *Acid lakes, *Transparency, *Thermal regime, Neutralization, Chlorophyll, Phytoplankton, Phosphorus, Epilimnion, Hypolimnion, Solar heating, Lohi Lake, Ontario.

Prior to experimental neutralization in the fall of 1973, the pH of Lohi Lake was 4.4. The pH was maintained at >6.0 by further small additions of base in 1974 and 1975, but it subsequently declined, reaching 4.74 by 1979. Secchi transparency (depth) averaged over the ice-free season in Lohi Lake varied from 5.6 to 9.3 m. Secchi depth was not correlated with chlorophyll concentrations, phytoplankton biomass or total phosphorus, but it was negatively correlated with pH. Secchi depth was positively correlated with thermocline depth, epilimnetic thickness, and hypolimnetic heating rates suggesting that acidification should result in deeper mixing zones and warmer hypolimnia in lakes. The most probable cause of the increase in hypolimnetic heating rate following re-acidification of the lake is increased direct solar heating of the hypo-

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limnetic waters because of increased light penetration. (Moore-IVI)
W84-01974

NUTRIENT LIMITATION IN TWO ARCTIC LAKES, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
G. A. McCoy.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 8, p 1195-1202, August, 1983. 7 Fig, 17 Ref. EPA contract EPA-78-D-X0378.

Descriptors: *Limiting nutrients, *Arctic lakes, *Alaska, Bioassay, Selenastrum, Phosphorus, Nitrogen, Phytoplankton, Standing crop, Dissolved oxygen, Chlorophyta, Primary productivity, Fertilizers.

Batch-culture algal bioassays of Selenastrum capricornutum were used to predict the limiting nutrient in two small arctic-tundra lakes in 1979. In 1980 bioassays were performed again, and fertilizer was added to the lakes to test the predictions made from the 1979 bioassay results. In 1980, after the addition of phosphorus fertilizer, phytoplankton standing crop increased about 10-fold. After the addition of nitrogen fertilizer, another 10-fold increase in phytoplankton growth was measured. Concurrently, maximum daytime dissolved oxygen increased from 100 to 150% saturation, and pH increased from 7.0 to about 9.2. Further additions of fertilizer in late August and early September 1980 caused no significant increase in primary production. If the nitrogen content of the lake water is increased but that of phosphorus is not, no increase in algal growth occurs. Growth increases with phosphorus additions, but the magnitude of this increase is determined by the available nitrogen. When additional nitrogen is supplied to the system, further increases in algal growth occur. When nitrogen and phosphorus are supplied in excess, physical factors such as light or temperature become limiting in the lakes. (Author's abstract)
W84-01977

HYPOLIMNETIC AERATION OF A NATURALLY EUTROPHIC LAKE: PHYSICAL AND CHEMICAL EFFECTS,
British Columbia Ministry of the Environment, Vancouver. Fisheries Research and Technical Services Section.
For primary bibliographic entry see Field 5G.
W84-01978

ORTHOPHOSPHATE TURNOVER TIME IN SHALLOW PRODUCTIVE LAKES,
Alberta Univ., Edmonton. Dept. of Zoology.
E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 9, p 1412-1418, 2 Fig, 4 Tab, 21 Ref.

Descriptors: *Orthophosphate, *Productivity, *Lakes, Thermal stratification, Nutrients, Turnover time, Shallow lakes, Canada.

Orthophosphate turnover times were measured in 18 small and medium-sized lakes in western Canada. Turnover times in eight thermally stratified lakes were similar to those of other Canadian lakes: moderately rapid (up to 42 min) in the spring, increasing to very rapid (3-16 min) during July and August. Turnover times in the shallow (i.e. those which mixed intermittently during summer) productive lakes were far more variable, ranging from 17 min to 17 h in spring and 2 min to 36 h during July and August. For individual shallow lakes turnover times remained constant for particular summers. One shallow lake was studied over two summers. In the first summer, turnover times were extremely slow (7-36 h) and in the second summer they were extremely rapid (2-11 min). Therefore the mechanisms controlling nutrient limitation in shallow productive lakes are not constant, and can vary dramatically from year to year. (Author's abstract)
W84-01979

TROPHIC STATE CLASSIFICATION OF LAKES WITH AQUATIC MACROPHYTES,
Florida Univ., Gainesville. Center for Aquatic Weeds.
D. E. Canfield, Jr., K. A. Langeland, M. J. Maceina, W. T. Haller, and J. V. Shireman.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 10, p 1713-1718, October, 1983. 5 Tab, 33 Ref. Dept. of Agriculture cooperative agreement 58-7B30-0-177.

Descriptors: *Aquatic plants, *Macrophytes, *Phosphorus, *Trophic state, Nutrients, Lakes, Florida.

Conventional criteria for classifying trophic state emphasize conditions in the open water and ignore the nutrients, plant biomass, and production associated with macrophytes. A method is proposed for determining the potential water column nutrient concentration through adding the nutrients contained in macrophytes to those in the water. During September and October 1981, six Florida lakes with different limnological characteristics were sampled to determine the biomass of submersed aquatic macrophytes. In these lakes, total submersed macrophyte biomass ranged from 18,100 kg dry wt to 2,170,000 kg dry wt. For calculated potential water column phosphorus concentrations, 20-96% of the phosphorus was in the submersed macrophytes and the total water column phosphorus content (WCP) values were 1.2 to 26 times the measured open water concentrations. The effect of these macrophytes on WCP values and therefore on trophic state assessments depends on the amount of macrophytes relative to the total lake volume. Macrophytes have little effect on trophic state assessment when less than 25% of the phosphorus in the water column is associated with macrophytes and the mean macrophtye concentration in the lake is less than 1 g dry wt/cu m. (Moore-IVI)
W84-01981

HYDROGEOCHEMISTRY OF LAKE TURKANA, KENYA: MASS BALANCE AND MINERAL REACTIONS IN AN ALKALINE LAKE,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
R. F. Yuretich, and T. E. Cerling.
Geochimica et Cosmochimica Acta, Vol. 47, No. 6, p 1099-1109, June, 1983. 7 Fig, 5 Tab, 42 Ref.

Descriptors: *Geochemistry, *Mass balance, *Minerals, *Lake Turkana, Kenya, Interstitial water, Chemical reactions, Chloride, Sodium, Cation exchange, Calcium, Alkalinity, Sediments, Silicates, Alkaline lakes, Chemical precipitation.

Lake Turkana, in northwestern Kenya, is a closed-basin, alkaline (pH = 9.2) lake of moderate salinity (TDS = 2500 ppm). Principal ions are Na(+), HCO3(-) and Cl(-). The lake is essentially polymictic in the northern basin and little compositional variation occurs in surface water. The Omo River is the principal influent, providing some 80-90% of water input to the lake. Chloride has an apparent accumulation time of about 2500 years after accounting for burial of interstitial water. The bottom sediments are predominantly detrital and fine-grained, yet mineral-water reactions are very important for the geochemical budget. Ca(2+) is precipitated as calcite; Na(+) is removed as an exchangeable cation on smectite; Mg(2+) is probably incorporated into a Mg-silicate phase, most likely poorly-crystalline smectite, as it enters the lake water; K(+) may be used in illite regradation. Cation exchange is a very important process in the mass balance of this lake. Over 40% of incoming Na is removed as an exchangeable cation. After cation exchange and interstitial water burial, Na has a response time of 2650 years, which compares favorably with that of chloride. These processes seem to occur rapidly within the water mass of the lake; other reactions may be important in regulating interstitial water compositions. Several changes occur in the upper 3m of sediment: interstitial-water pH drops to 8.3 and alkalinity increases slightly with depth, SO4(2-) decreases slightly, and amorphous silica saturation is approached. These changes are a response to organic matter oxidation and the dissolution of unstable silicates rather than a reversal of reactions occurring in the lake water. High rates of sedimentation (up to 1 cm per year) may minimize the effects of diffusion between the interstitial waters and the lake water, although burial of interstitial water assumes considerable importance. (Author's abstract)
W84-01985

COMPARISON OF THE FORMULATION FOR EDDY DIFFUSION IN TWO ONE-DIMENSIONAL STRATIFICATION MODELS,
Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers, M. J. McCormick, and D. Scavia.
Applied Mathematical Modelling, Vol. 7, No. 3, p 212-215, June, 1983. 1 Fig, 24 Ref. DOE contract DE-AC02-79EV10005.

Descriptors: *Thermal stratification, *Eddy diffusion, *Mathematical models, Lakes, Wind, Water circulation, Water depth.

Models for thermal stratification based on turbulent diffusion concepts by Henderson-Sellers (J. Limnol. Soc. sth. Afr. 1980, 6, 49); and by McCormick and Scavia (Water Resour. Res. 1981, 17, 305), are shown to be equivalent at large values of the Richardson number, Rj. At small Rj, the simpler model reverts to specification of the turbulent diffusion as a constant value. This simplification is also demonstrated to be a realistic approximation only at low wind speeds and for deep lakes. By comparison of these model types, a parameter B (previously empirically defined by McCormick and Scavia) is related conceptually to the lake depth, H. Both model types have been used with success in lake stratification simulations. The equivalence of the parameterizations for the eddy diffusion coefficient has been shown under the constraints of constant current shear, high Richardson number, and low wind speed. The differences lie in the treatment of areas of low diffusion rates: the Henderson-Sellers model uses the turbulent diffusion coefficient at all depths, whereas the other model specifies a critical depth below which the value of K is taken as the thermocline minimum. (Moore-IVI)
W84-01995

ANAEROBIC OXALATE DEGRADATION: WIDESPREAD NATURAL OCCURRENCE IN AQUATIC SEDIMENTS,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. L. Smith, and R. S. Oremland.
Applied and Environmental Microbiology, Vol. 46, No. 1, p 106-113, July, 1983. 4 Fig, 3 Tab, 27 Ref.

Descriptors: *Oxalate, *Sediments, *Decomposition, Anaerobic conditions, Lake sediments, Mud flats, Salt marshes, Aquatic environments, Detritus, Saline lakes, Searsville Lake, Lake Tahoe, South San Francisco Bay, California, Big Soda Lake, Nevada.

Significant concentrations of oxalate (dissolved plus particulate) were present in sediments taken from a diversity of aquatic environments, ranging from 0.1 to 0.7 mmol/liter of sediment. These included pelagic and littoral sediments from two freshwater lakes (Searsville Lake, Calif., and Lake Tahoe, Calif.) a hypersaline meromictic, alkaline lake (Big Soda Lake, Nev.), and a South San Francisco Bay mud flat and salt marsh. The oxalate concentration of several plant species which are potential detrital inputs to these aquatic sediments ranged from 0.1 to 5.0% (wt/wt). In experiments with litter bags, the oxalate content of Myriophyllum sp. samples buried in freshwater littoral sediments decreased to 7% of the original value in 175 days. This suggests that plant detritus is a potential source of the oxalate within these sediments. (C-14)oxalic acid was anerobically degraded to (C-14)CO2 in all sediment types tested, with higher rates evident in littoral sediments than in the pelagic sediments of the lakes studied. The turnover time of the added (C-14)oxalate was less than 1 day in Searsville Lake littoral sediments.

total sediment oxalate concentration did not significantly between littoral and pelagic sedi- s and therefore did not appear to be control- the rate of oxalate degradation. However, n profiles of (C-14)oxalate mineralization and lved oxalate concentration were closely cor- ed in freshwater littoral sediments; both were est in the surface sediments (0 to 5 cm) and eased with depth. The dissolved oxalate con- ation (9.1 micromol/liter of sediment) was 3% of the total extractable oxalate (277 mi- ol/liter of sediment) at the sediment surface. e results suggest that anaerobic oxalate degra- n is a widespread phenomenon in aquatic sedi- s and may be limited by the dissolved oxalate entration within these sediments. (Author's act)
02051

SITIVITY OF AN OLIGOTROPHIC LAKE NKTONIC BACTERIAL COMMUNITY TO GEN STRESS,
nia Polytechnic Inst. and State Univ., Blacks- Dept. of Biology.
Mikell, Jr., B. C. Parker, and G. M. ons, Jr.
ied and Environmental Microbiology, Vol. o. 3, p 545-548, September, 1983. 4 Tab, 13 NSF grant DPP-12988.

riptors: *Dissolved oxygen, *Supersaturation, teria, Plankton, Oligotrophic lakes, Antarctic, th, Metabolism, Superoxide dismutase, Cata- Mountain Lake, Giles County, Virginia.

ng the relatively few known natural aquatic onments in which prolonged or permanent dissolved oxygen (HDO) conditions occur are n oligotrophic, perennially ice-covered lakes valleys of southern Victoria Land, Antarcti- o develop techniques for studying those Ant- lakes and to obtain base-line data for com- on, an investigation was undertaken of the tonic microbial community in Mountain Giles County, Virginia during the summer of Dissolved oxygen at approximately four normal saturation (42 mg/l) inhibited the th and metabolism of summer planktonic bac- in the surface water of alpine oligotrophic ntain Lake. Data were derived from growth FU on membrane filters, C-14 labeled D- se incorporation into the extractable lipid of CFU, and respiration and assimilation of d D-glucose by lake water samples. Statisti- significant (alpha < 0.05) differences were etected in either CFU or C-14 incorporation id when superoxide dismutase (30 U/ml) or se (130 U/ml) was added to the medium. exogenous oxygen by-products apparently ot responsible for the observed inhibition of th and metabolism. (Moore-IVI)
02057

Water In Plants

ER BUDGET OF AN EASTERN DECIDU- FOREST STAND,
Ridge National Lab., TN. Environmental Sci- Div.
Luxmoore.
Science Society of America Journal, Vol. 47, , p 785-791, July-August, 1983. 6 Fig, 1 Tab, f. DOE contract W-7405-eng-26.

riptors: *Soil water, *Soil water potential, er budget, *Forests, Hydraulic gradient, Sea- variation, Simulation, Mathematical models, otranspiration, Root zone.

water content and soil matric potential were ored during 2 years at two neighboring top sites in an oak-hickory stand on a Typic dult forest soil with cherty silt loam texture. aulic gradients and soil water contents ed distinct seasonal variation. Soil water dy- s and water budgets were simulated with a lant-atmosphere water flow model using rologic, soil, and plant characteristics esti- l for the two sites. A seasonal pattern of soil drainage and upward fluxes was predicted by the model that corresponded with the field-determined hydraulic gradients. Recharge of water up into the root zone (0- to 90-cm depth) from lower depths was predicted to contribute an average of 9 and 29% of the soil evaporation plus transpiration water loss at the two sites. Total evapotranspiration, including interception evaporation, was similar at the two sites; however, the greater upward water flux at one site compensated for the lower soil water capacity in the root zone at that site. There were significant differences between calculated and simulated daily drainage rates. Simulated soil water contents for the two study sites differed somewhat from measured values obtained on specific days. At longer time scales, the annual water budgets simulated for the sites were similar and were in reasonable agreement with measurements from a local watershed study. Annual evapotranspiration was predicted to be 74.5 cm for the ridge-top forest stand, somewhat higher than the average of 70.5 cm estimated for the whole watershed. (Author's abstract)
W84-01871

2J. Erosion and Sedimentation

EARLY EUTROPHICATION IN THE LOWER GREAT LAKES: NEW EVIDENCE FROM BIOGENIC SILICA IN SEDIMENTS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W84-01840

RELATIVE ERODIBILITY OF 20 CALIFORNIA RANGE AND FOREST SOILS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
K. E. Trott, and M. J. Singer.
Soil Science Society of America Journal, Vol. 47, No. 4, p 753-759, July-August, 1983. 2 Fig, 6 Tab, 42 Ref.

Descriptors: *Soil erosion, *Erodibility, Mineralogy, Clays, Soil texture, Mathematical models, Universal Soil Loss Equation, California.

The Universal Soil Loss Equation's K nomograph may not account for all of the factors affecting erodibility of western upland soils. To further investigate this, laboratory rainfall simulation on 0.6- by 0.6-m plots of sieved soil at 9% slope was used to measure relative erodibility of 20 upland soils, including two soils from terraces of the Sacramento River. The most powerful predictor in a stepwise multiple regression of erodibility, on a mass basis, was a combined smectite plus vermiculite clay mineralogy term. Also included in the four-variable regression equation were bulk density, pyrophosphate-extractable Fe + Al, and the standard texture term M. R(2) for the equation was 0.800. Smectite plus vermiculite, M, a clay mineralogy-pyrophosphate Fe + Al interaction term, pH, organic matter, oxalate Fe + Al, and vermiculite were the seven significant terms in the equation predicting soil loss on a volume basis. This equation had an R(2) of 0.772. For now, the best available tool for predicting erodibilities of western upland soils appears to be the Universal Soil Loss Equation erodibilities nomograph. Because of the large differences in parent materials and soil-forming conditions that distinguish midwestern from western soils, consideration of soil mineralogy in future predictive work may improve the predictive capacity of the nomograph. There may be value in examining direct and indirect indicators of soil parent material and soil development with regard to predicting erodibility. (Moore-IVI)
W84-01867

MATHEMATICAL MODEL OF SOIL EROSION AND DEPOSITION PROCESSES: I. THEORY FOR A PLANE LAND ELEMENT,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, J. R. Williams, G. C. Sander, and D. A. Barry.
Soil Science Society of America Journal, Vol. 47, No. 5, p 991-995, September-October, 1983. 1 Fig, 17 Ref.

Descriptors: *Soil erosion, *Soil deposition, Mathematical models, Kinematic flow, Sedimentation, Rainfall detachment, Soil entrainment, Overland flow, Slope, Runoff.

A new mathematical model of soil erosion and deposition on a plane land element makes use of an approximate analytic theory of runoff on a plane assuming kinematic flow. Plane land elements are important landscape elements in both farmed and natural systems. Rates of the following simultaneously occurring erosion/deposition processes are represented mathematically: rainfall detachment, sediment deposition, and soil entrainment by overland flow. The concept of stream power is used in representing the entrainment process. The form of analysis reduces the first-order partial differential equation expressing conservation of mass of sediment to an ordinary differential equation, which can thus be solved analytically. This solution gives sediment concentration at any time as a function of distance down the plane in terms of four defined soil factors, the slope of the land, two separate cover factors, and the rainfall and runoff rates. The product of water flux and sediment concentration gives sediment flux at any time and position on the plane. (Moore-IVI)
W84-01874

MATHEMATICAL MODEL OF SOIL EROSION AND DEPOSITION PROCESSES: II. APPLICATION TO DATA FROM AN ARID-ZONE CATCHMENT,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, J. R. Williams, G. C. Sander, and D. A. Barry.
Soil Science Society of America Journal, Vol. 47, No. 5, p 996-999, September-October, 1983. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Soil erosion, *Soil deposition, *Arid lands, Runoff, Sediment concentration, Mathematical models, Sediment entrainment, Soil detachment, Overland flow, Arizona.

Mathematical theory for soil erosion and deposition processes on a plane land element was applied to data on runoff and sediment concentration as a function of time for nine runoff events from a small (1.3 ha) arid watershed in Arizona. Sediment concentration (and therefore sediment flux) vs. time measured at the exit to the watershed could be matched by the theory using particular values of two physically defined parameters. These two parameters are essentially the detachability of soil to rainfall, and the efficiency of sediment entrainment by overland flow. The first parameter had greatest effects on sediment concentration early in any runoff event, and the second parameter dominated later concentrations, thus allowing almost independent assessment of both parameters. The variation in soil detachability with mean depth of overland flow derived from the field data bore similarities to controlled laboratory observations. (Author's abstract)
W84-01875

EFFECT OF CROP RESIDUE, TILLAGE-INDUCED ROUGHNESS, AND RUNOFF VELOCITY ON SIZE DISTRIBUTION OF ERODED SOIL AGGREGATES,
N. P. Cogo, W. C. Moldenhauer, and G. R. Foster.
Soil Science Society of America Journal, Vol. 47, No. 5, p 1005-1008, September-October, 1983. 5 Fig, 16 Ref.

Descriptors: *Soil erosion, *Soil aggregates, *Tillage, *Crop residues, *Velocity, Plowing, Flow rate, Sediment transport, Conservation tillage, Roughness.

The percentages of eroded soil aggregates over 10 size classes ranging from 0.002 to 2.0 mm in diameter as affected by crop residue cover, tillage-induced roughness, and water flow velocity were investigated under field conditions using simulated rainfall. The soils used were a 4.5% slope Russell silt loam and a 6.5% slope Martinsville loam. With no vegetation present, the smallest eroded aggre-

gates came from a chisel-plowed surface while the largest came from chisel- and moldboard-plowed surfaces which had been disked. A no-till treatment gave intermediate values. The D50 size (the aggregate size which 50% of the aggregates exceed) in the absence of soil cover was 0.033, 0.032, 0.020, and 0.011 mm for chisel plow plus disk, moldboard plow plus disk, no-till and chisel plow, respectively. When soil was covered by residue, and size distribution of the eroded aggregates was not greatly different among the tillage treatments. The D50 size was reduced in this case to about 0.012 mm for all tillage systems. For no-till, the percentage of the eroded aggregates > 0.05 mm decreased exponentially (r(2) = 0.85) with an increase in residue cover. Under chisel plowing residue was not effective in reducing the quantity of larger aggregates in the runoff. An increase in flow rate caused an increase in water flow velocity which, in turn, caused a linear (r(2) = 0.94) increase in the percentage of the eroded aggregates > 0.05 mm, for chisel plowing. The results from this study were explained in terms of sediment trapping capacity of the soil surface, as well as runoff transport capacity. (Author's abstract)
W84-01877

CHARACTERISTIC PARAMETERS OF NONEQUILIBRIUM PROCESSES IN ALLUVIAL CHANNELS OF FINITE LENGTH,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
W. F. Jaramillo, and S. C. Jain.
Water Resources Research, Vol. 19, No. 4, p 952-958, August, 1983. 8 Fig, 25 Ref.

Descriptors: *Sediment transport, *Alluvial channels, Sedimentation, Model studies, Aggradation, Degradation.

An analytical solution for the characteristic parameters of the nonequilibrium processes of aggradation due to sediment augmentation and degradation due to sediment diminution in alluvial channels of finite length is presented. The analytical solution for small time agrees with that for a semiinfinite channel. The analytical solution is compared with the available experimental data. Aggradation and degradation processes are similar to each other and their characteristic parameters are governed by the same equations. The analytical solution for small time is identical to that for a semi-infinite reach. The latter may be considered as a special case of the more general solution presented. The deviation of the experimental data from the analytical results is due to the two simplifications introduced in the model. The experimental results agree with the analytical results for moderate values of sediment overloading. (Baker-IVI)
W84-01888

SEDIMENT DEPOSITION ESTIMATION FROM CESIUM-137 MEASUREMENTS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
J. K. Mitchell, S. Mostaghimi, D. S. Freeny, and J. R. McHenry.
Water Resources Bulletin, Vol. 19, No. 4, p 549-555, August, 1983. 4 Fig, 5 Tab, 9 Ref.

Descriptors: *Soil erosion, *Sedimentation, Watershed management, Waterway vegetation, Buffers, Soil conservation, Sediment deposition, Water depth, Allerton watershed, 4-H Memorial Lake, Illinois.

The movement of fallout Cs-137 carried by soil particles was studied as an indicator of erosion and sedimentation in the Allerton watersheds and 4-H Memorial Lake located near Monticello, Illinois. Sediment deposition was greater in the waterway draining from watershed IB than in the waterway from watershed IA. At the average rate of 2.3 cm/yr of sediment deposition in the lake (from 1954 to 1979), there will be a loss of over 2 m of water depth in the next century. However, there appears to be a decreasing rate of sediment deposition in the 4-H Memorial Lake as a result of improved conservation practices on the watersheds and the increased effectiveness of vegetated waterways and buffers for retaining sediment. (Author's abstract)
W84-01938

PREDICTING EROSION AND DEPOSITION ON A STRIPMINED AND RECLAIMED AREA,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
R. M. Khanbilvardi, A. S. Rogowski, and A. C. Miller.
Water Resources Bulletin, Vol. 19, No. 4, p 585-593, August, 1983. 12 Fig, 1 Tab, 16 Ref. EPA-ARS Interagency Agreement grant EPA-IAG-D5-E763.

Descriptors: *Stripmines, *Soil erosion, *Land reclamation, Sediment deposition, Mathematical models, Rill erosion, Interrill erosion, Spatial distribution, Sediment transport, Pennsylvania.

A rill-interrill erosion model was applied to a mined and reclaimed area. Soil loss from the interrill areas was estimated by the Universal Soil Loss Equation (USLE). The model considers the fate and ultimate disposition of the sediment from interrill areas along with the fate and destination of soil materials detached by the rill flow. The net sediment loss was predicted by comparing, for a given flow, the amounts of eroded soil to rill transport capacity. The experimental area was a small reclaimed site in Central Pennsylvania. The model was used to analyze the distribution of comulative soil loss for five storm events, which occurred in the summer of 1981. The output consisted of a map showing erosion or deposition on each 10 x 10 ft subarea at the experimental site. The significant advantage of the model was its ability to predict areal distribution of erosion and deposition. On the average, the predicted results differed from measure erosion and deposition at a point by 25%. Although developed for stripmined and reclaimed areas, the model could be applied to predict erosion and deposition on agricultural watersheds as well as urban watersheds. (Moore-IVI)
W84-01944

2K. Chemical Processes

BRACKISH-WATER AQUACULTURE IN PYRITE-BEARING TROPICAL SOILS,
Lamont-Doherty Geological Observatory, Palisades, NY.
H. J. Simpson, H. W. Ducklow, B. Deck, and H. J. Cook.
Aquaculture, Vol. 34, No. 3/4, August, 1983. 5 Fig, 5 Tab, 26 Ref.

Descriptors: *Pyrite, *Aquaculture, *Leaching, Tropical regions, Brackish water, Acidity, Oxidation, Iron, Sulfur, Southeast Asia, Malaysia.

Oxidation of pyrite in soils and sediments of coastal areas yields large amounts of acid, as well as soluble iron and aluminum, which seriously reduce yields of aquaculture organisms. Potential for this problem is widespread in tropical and subtropical areas, especially for brackish-water aquaculture in Southeast Asia. Data on water, sediment and soil chemistry at a new aquaculture facility in peninsular Malaysia are reported to document environmental conditions during the initial years of operation when the yields of food organisms are low. Estimated rates of leaching of acid from the pyrite-bearing dike soils suggest that acidity problems will probably persist at this facility for a number of years. Ways to minimize the problems include the fact that extensive soil survey work should be performed prior to site selection and construction of aquaculture facilities. Dike system design should be such that it will minimize soils exposed to the atmosphere. Serious planning as to the acid sensitivity of the potential culture organisms should be made. Systematic collection of water quality data related to acidity impacts should be made on a routine basis to monitor rate and pattern of removal of acidity from the system. (Baker-IVI)
W84-01834

PHOSPHORUS AND CALCIUM CARBONATE SOLUBILITIES IN LAKE KINNERET,
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 2H.
W84-01836

DEVELOPMENT OF REACTION MODEL FOR GROUND-WATER SYSTEMS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W84-01984

HYDROGEOCHEMISTRY OF LAKE TU KANA, KENYA: MASS BALANCE AND MIN ERAL REACTIONS IN AN ALKALINE LAK
Massachusetts Univ., Amherst. Dept. of Geolog and Geography.
For primary bibliographic entry see Field 2H.
W84-01985

NUMERICAL EXAMINATION OF THE ELU TION OF AQUATIC SEDIMENTS (RECHNER ISCHE BEHANDLUNG DER ELUTION VO SEDIMENTEN),
Technische Hochschule, Darmstadt (Germany F.R.). Inst. fuer Wasserversorgung, Abwasserbe seitigung und Raumplanung.
H. Schreiner.
Zeitschrift fur Wasser und Abwasser Forschung Vol. 16, No. 3, p 96-107, 1983. 9 Fig, 3 Tab, 2 Ref.

Descriptors: *Sediments, *Elution, Lake sedi ments, Oxidation, Diffusion, Ammonium, Wate quality.

In slowly running waters or lake bottoms, sediments are formed. Permanent interactions exist between these sediments and the fresh water. The mechanisms of these exchanges are consolidation, diffusion and convection of gas. The processes affect the quality of the sediment and of the overlying water. The concentration of the most reduced substances in the sediment is more intensive than in the body of water. Therefore the interactions between sediments and water lead to a slow elution of the sediments. More than that, the sediment usually has a high demand of oxidizing agents. The elution of aquatic sediments was examined in laboratory scale experiments and generally described by the principals of diffusion. An example of ammonium as verification of experimental results is performed. (Author's abstract)
W84-02068

COMMON COMPOSITION CHARACTERISTICS OF FLUORIDE BEARING GROUND-WATERS,
Andhra Univ., Waltair (India). Dept. of Geophysics.
For primary bibliographic entry see Field 2F.
W84-02124

2L. Estuaries

SEDIMENTATION, ACCRETION, AND SUBSIDENCE IN MARSHES OF BARATARIA BASIN, LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. S. Hatton, R. D. DeLaune, and W. H. Patrick, Jr.
Limnology and Oceanography, Vol. 28, No. 3, p 494-502, May, 1983. 5 Fig, 3 Tab, 29 Ref.

Descriptors: *Marshes, *Sedimentation, *Accretion, Brackish water, Salt marshes, Louisiana, Barataria Basin.

Vertical accretion and sediment accumulation rates were determined from the distribution of Cs-137 in cores collected from freshwater, intermediate, brackish, and salt marshes in the Barataria Basin, Louisiana. Vertical accretion rates vary from about 1.3 cm/yr in levee areas to 0.7 in backmarshes. Mineral sediment content of the marsh soil profile decreased with distance from the coast. However, vertical accretion rates were about equivalent in areas of the same type. Autochthonous organic

appears to be an important factor defining
cess and rate of vertical accretion, especial-
he freshwater marshes. Except in natural
reas, march accretion rates are less than
nce measured by water level data; however
ne cannot account for observed land-loss
s in the basin area. Management practices
burning and channelization with salt water
n, which may retard the production and
lation of organic matter, have serious con-
es for marsh accretion and land loss.
IVI)
835

G OUR NATION'S WETLANDS,
ttee on Environment and Public Works
enate).
hafee.
ournal, No. 2, p 3-4, October, 1983. 1 Fig.

tors: *Wetlands, *Water resources devel-
, Environmental effects, Recreation, Fish
ions, Habitats.

ed to conserve wetlands has never been
ritical than it is today. At present, the
ation and the destruction of wetland habitat
ngle most important factor affecting migra-
terfowl abundance. Wetlands also contrib-
the production of a rich commercial and
onal fishery harvest. They also provide rec-
l activities other than fishing. Wetlands
natural wastewater treatment plants. They
and moderate runoff after heavy precipita-
snowmelt. They also aid in well recharge
g as natural sponges. (Baker-IVI)
999

ROBIC OXALATE DEGRADATION:
SPREAD NATURAL OCCURRENCE IN
TIC SEDIMENTS,
ical Survey, Menlo Park, CA. Water Re-
Div.
mary bibliographic entry see Field 2H.
051

ATER SUPPLY
GMENTATION
D CONSERVATION

aline Water Conversion

GETIC EFFICIENCY OF MSF PROCESS
HE CONDITIONS OF DESALINATION
STE HEAT,
Univ. (China). Dept. of Chemical Engi-
chang.
ation, Vol. 44, p 39-49, 1983. 2 Tab, 4 Ref.

tors: *Desalination plants, *Thermodynam-
ency, *Exergenetic efficiency, Brine recir-
, Cooling water.

ergy losses and thermodynamic efficiency
plants with brine recirculation are dis-
by means of temperature difference (TD)
s. In a MSF plant, the irreversible losses
nd mainly in irreversible heat-transfer and
aporation processes. The basic variables are
perature drop from stage to stage, and the
ature differences between flashed vapor and
water. The flash temperature difference
, the heat transfer TD function, and the
D function are suggested. The proposed TD
s of MSF plants provides a convenient
analyze the irreversible behavior and evalu-
exergetic efficiency of this system, because
such improvement the calculation of the
c efficiency of a MSF plant according to
sical formula will be not only inconvenient
insignificant. As a result of present analy-
reasonable parameters based on the energy
ption are easily chosen. The principles are
ed by study of typical commercial plants in
Kong and Shuwaikh, Kuwait, and a pilot
Tianjin, China. The key to saving energy in commercial plants is to make a great effort to reduce the irreversible losses. (Moore-IVI)
W84-02023

SEAWATER VS. BRACKISH WATER DESALTING: TECHNOLOGY, OPERATING PROBLEMS AND OVERALL ECONOMICS,
Mekoroth Water Co., Tel Aviv (Israel).
P. Glueckstern, and Y. Kantor.
Desalination, Vol. 44, p 51-60, 1983. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Desalination, *Seawater, *Brackish water, Reverse osmosis, Membrane processes, Drinking water, Water quaility, Costs, Energy.

Current operation of seawater and brackish water desalting plants is reported and analyzed regarding operating problems and costs. When properly maintained, desalting plants can be considered reliable sources for augmentation of water supply and water quality improvement. Current actual operation costs emphasize the great difference in cost between desalting brackish water by membrane processes and desalting seawater by thermal processes. Quality improvements of drinking water can be very simple and relatively inexpensive. Recent developments in reverse osmosis technology have made brackish water desalting competitive in many cases with conventional water supply. The potential for further development of seawater desalting is still quite large and its realization in due time is very important in order to avoid prohibitive costs for many applications, especially for those with prevailing or projected high energy costs. (Moore-IVI)
W84-02024

ONE YEAR OF OPERATION OF ISRAEL DESALINATION ENGINEERING'S MULTI-EFFECT DISTILLATION U.S. VIRGIN ISLANDS,
Israel Desalination Engineering Ltd., Tel-Aviv.
U. Fisher.
Desalination, Vol. 44, p 73-84, 1983. 6 Fig, 2 Ref.

Descriptors: *Desalination plants, *Multi-effect distillation, Drinking water, Virgin Islands, St. Thomas, St. Croix, Scaling.

Three MED (multi-effect distillation) plants for 1.25 MGD were installed in St. Thomas and St. Croix by Israel Desalination Engineering. The Low Temperature MED plants made of horizontal aluminum tubes exceeded the acceptance criteria and continuously supply drinking water to the islands with purity of 16 ppm TDS. Since late 1981 the availability has exceeded 97% and the performance ratio is 12.4 or better. Annual average production was 1.3, 1.3 and 1.27 MGD. The most notable advantages of the MED plants are: the easy start up and operation of the MED process and short period between start up and full capacity; Specific Power Consumption does not change markedly when operating on partial load; low temperature operation results in nearly scale free plant and allows for the use of less expensive construction materials. (Author's abstract)
W84-02025

CAPACITY ADAPTION OF REVERSE OSMOSIS SYSTEMS BY TEMPERATURE AND PRESSURE CONTROL OF THE RAW WATER,
Deutsche Babcock A.G., Krefeld (Germany, F.R.).
K. Heybach.
Desalination, Vol. 44, p 85-90, 1983. 3 Fig, 1 Ref.

Descriptors: *Desalination, *Reverse osmosis, Pressure, Temperature effects, Water treatment.

Permasep Permeator Systems have a permeate capacity variation of nearly three percent for every degree centigrade of temperature variation. The idea of using this temperature phenomenon for the adaption of capacity in permeate production as required over the day originated during the planning stage for three plants of nominal 30 cu m/hr capacity including reverse osmosis system for the production of ultra pure water for electronics. The consumption of permeate subsequently treated to ultra pure quality varied between 30 and 100% of the nominal capacity in the course of the day. The general design of a plant producing ultra pure water is described. The clear and simple relationship between temperature, pressure and feed water, permeate and concentrate flow rates would allow control by microprocessor system and automatically operating valves. This means that there is indeed a capacity adaption for reverse osmosis systems. (Baker-IVI)
W84-02026

DESALTING WATER COSTS USING WASTE HEAT FROM POWER SYSTEMS COMBINED WITH THE VTFE AND VAPOR COMPRESSION,
Ebasco Services, Inc., New York.
S. J. Senatore.
Desalination, Vol. 44, p 129-135, 1983. 2 Fig, 1 Tab, 1 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Multistage flash evaporator, *Vertical tube foaming evaporator, Costs, Energy, Powerplants, Key West, Florida.

An updated desalted water cost comparison is presented for the reverse osmosis (RO), multistage flash evaporator (MSF) and the high efficiency performance vapor compression vertical tube foaming flow evaporator (VCVTFE). The capital costs of the VCVTFE plant is based on a realistic conceptual design for a 2.5 mgd single purpose plant. Together with the vapor compression cycle, high performance ratios of about 35 lbs. product per 1000 Btus can be readily achieved. These high efficiency concepts and use of waste heat are economical with current day high fuel costs. Projected bottom line water costs show that the VCVTFE process is more economical than RO, which is cheaper than MSF desalting costs at today's high energy costs. Power plant turbine exhaust steam normally rejected to the ocean through seawater-cooled condensers, can be used to produce distilled water with an efficient vertical tube foaming flow (VTFE) evaporative condenser. This waste heat VTFE plant was designed to provide 150 cu m per day of distillate having about 5 ppm of total dissolved salts, for use of boiler feed at a 37 MWe coastal power plant at Key West, Florida. The energy cost of the VCVTFE process is only 51% of the energy cost of the RO process. (Moore-IVI)
W84-02027

SEAWATER DESALINATION WITH VERY LOW ENERGY CONSUMPTION,
Bavaria Anlagenbau G.m.b.H., Fuerstenfeldbruck (Germany, F.R.).
L. Cavalieri, and G. Nasser.
Desalination, Vol. 44, p 143-151, 1983. 5 Fig, 3 Tab.

Descriptors: *Desalination apparatus, *Multiple effect process, *Heat exchangers, Vertical tube evaporation, Multi-stage flash evaporation, Corrosion resistance, Scaling, Seawater, Bavaria.

Based on a new plate heat exchanger design, a large scale prototype desalination plant, operating as multiple effect process (vertical tube evaporation (VTE) and multi-stage flash (MSF) process) has been erected in Bavaria. Compact completely welded titanium plate heat exchangers allows the vertical arrangement of 55 stages within a pressure box of 34 m height, 2.5 x 3.2 m ground area, generating a fresh water output of 5000 cu m/day with a Performance Ratio of > 40 (tons of fresh water per ton of supplied steam). A 55 stage VTE evaporator section is combined with a 75 stage MSF section, operating from 130 C down to 30-35 C for maximized steam economy. All heat exchangers are manufactured of titanium while all internal box surfaces in contact with seawater are made of monit, for corrosion resistance. Scaling is minimized as brine is passed once through the plant, and operation with reduced pH values presents no corrosion danger. A large pressure number is feasible in view of the compact heat

exchanger design and the stage interconnecting internal baffle system which avoids external pipework, and due to the automation of the plate heat exchanger manufacturing methods. (Moore-IVI)
W84-02028

SQUEEZING DESALTED WATER COSTS BY PROPER CHOICE OF THE DESALTING TECHNOLOGY AND WATER MANAGEMENT,
National Research Centre, Cairo (Egypt). Pilot Plant Lab.
A. M. Abulnour, M. H. Sorour, F. A. Hammouda, and A. M. Abdel Dayem.
Desalination, Vol. 44, p 189-198, 1983. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Desalination, *Water reuse, *Costs, Developing countries, Water management, Energy, Water conservation, Social aspects, Egypt.

Due to water shortages in many areas in Egypt, the wider utilization of desalination techniques is certain, but problems may be encountered due to the improper selection of the technological package, or conditions of the site itself. Guidelines for proper selection of the desalting technology are presented which may apply to similar developing countries. Factors which should be considered include: the socio-cultural setting of the community, technical skills in the community, conservation and water management practices, fuel prices, and the importance of incorporating waste disposal and reuse in the same package. The availability of reliable and cheap energy sources may be the most dominant criterion for the selection of a desalting technology. Wider utilization of dual desalination-reuse plants seems to be essential in remote seashore and desert communities. Industries that consume large amounts of energy and water should be discouraged until the time when more energy and water are available from cheap sources. (Moore-IVI)
W84-02029

SPECIFIC ENERGY RECOVERY PUMPING SYSTEM FOR REVERSE OSMOSIS DESALINATION,
Pompes Guinard, Annecy (France).
P. Goubeau, and P. Leroy.
Desalination, Vol. 44, p 199-206, 1983. 2 Fig, 2 Tab.

Descriptors: *Desalination, *Pumps, *Reverse osmosis, Seawater, Mechanical equipment.

The main advantages of reverse osmosis, as opposed to thermal processes, are the lower running costs, especially energy consumption, shorter delivery time, and the low temperature process, and all the energy being in the form of pressure. The problem now is to determine the best energy recovery pumping system: the integrated systems are those offering the greatest advantages in terms of cost savings and operating facilities. The integrated TPMDX energy recovery pumping system was designed by Pompes Guinard, which is one of the largest international pump manufacturers. The TPMDX system has the advantages of reliability, costs, flexibility, and short delivery time. (Baker-IVI)
W84-02030

EVALUATION AND DEVELOPMENT OF TECHNICAL THERMOPLASTIC SYSTEMS FOR DESALINATION AND OTHER WATER TREATMENT APPLICATIONS,
General Electric Plastics B.V., Bergen op Zoom (Netherlands).
G. Mossner.
Desalination, Vol. 44, p 325-327, 1983.

Descriptors: *Desalination, *Thermoplastics, Reverse osmosis, Lamella separator, Resins, Water treatment.

Successful applications and revolutionary new concepts for water treatment currently under development are considered, from an industrial point of view. Examples such as AQUANOVA (C.F.E.), GKSS (reverse osmosis), and PASSAVANT (lamella separator) are considered. NORYL resin is discussed as an excellent material possessing a combination of specific properties, virtually unique among engineering plastics. It is a modified polyphenyleneoxide offering a number of high performance properties. It lends itself well to heat treating methods, is corrosion resistant, chemical resistant and has favorable mechanical properties. (Baker-IVI)
W84-02031

OPERATING EXPERIENCE AND PERFORMANCE DATA ON AN ADVANCED BARGE-MOUNTED VTE/VC SEAWATER DESALINATION PLANT,
B. Ohlemann, and D. K. Emmermann.
Desalination, Vol. 45, p 39-47, 1983. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Desalination plants, *Vapor compression, *Vertical tube foam evaporation, *Multistage flash evaporation, MEDA, Helgoland, West Germany.

The floating desalination demonstration plant MEDA presents an advanced concept to produce fresh water from seawater with low energy consumption. This has been achieved by developing a new desalting system with the combination of vapor compression (VC), vertical tube evaporation with foamy upflow (VTFE) and multi-stage flash evaporation (MSF). MEDA was operated at Helgoland in the North-Sea at its design capacity of 5000 cu m/day and a performance ratio of 22 to 1 kg/kg. The 24 VTE effects evaporator combined with two vapor compression topping effects operated at a maximum feed temperature of 135 C with sulfuric acid pretreatment. High heat transfer rates were obtained using foamy upflow in double-fluted evaporator tubes without inter-effect pumps. Data were obtained for an alternative pretreatment system for feed make-up using a fluidized bed ion exchanger system operating in the countercurrent mode. Calcium ion content in the feedwater was demonstrably reduced by more than 90%. The practical feasibility of advanced desalting technology was sucessfully demonstrated. Performance ratios 2 to 3 times higher than MSF process are achievable. The successful demonstration of MEDA at Helgoland supports the acceptance of VC/VTFE or VTFE for single and dual purpose plants. (Moore-IVI)
W84-02032

FLOATING DESALINATION PLANTS; AN ENGINEERING, OPERATING AND ECONOMIC APPRAISAL,
Water and Electricity Dept., Abu Dhabi (United Arab Emirates).
M. Fadel, K. Wangnick, and N. M. Wade.
Desalination, Vol. 45, p 49-63, 1983. 3 Fig, 3 Tab.

Descriptors: *Desalination plants, *Floating desalination plants, *Costs, Construction costs, Barges, Standby plants, Abu Dhabbi.

The simplest type of floating plant consists of a basic pontoon or barge on which the distiller and auxiliary plant are mounted. The obvious attraction of such plants is that practically all construction can be carried out in the country of manufacture. The concept of a self-propelled seagoing plant introduces a large measure of flexibility into the operation of a floating desalination plant. For the relatively small extra costs of propulsion and navigation equipment, such a vessel can carry out several functions, such as: operation as a standby plant; providing reserve capacity to meet exceptional short term demands; and helping to meet rapidly increasing demand until completion of a land based plant. The first fully seagoing desalination vessel, named RUMAITH, is now in service in Abu Dhabi. This vessel carries two 1250 cu m/day MSF distillers and is complete with power generating plant and full marine and navigation facilities. Shore facilities are being engineered and constructed at three remote sites; Silaa, Sir Baniyas Island and Dalma Island. Facilities at each site include water unloading, water storage and pumping, fuel unloading, and fuel pumping. Excluding the shore facilities, the floating plant is shown to marginally lower in cost than a comparable l based plant. The addition of shore facilities permanent fuel and water connections by pipeli and offshore buoys will increase the cost of floating plant to some 7% above the land ba installation. The mobile plant will compete ef tively if regarded as a standby plant for a num of independent on-shore sites. (Moore-IVI)
W84-02033

SIMULATION OF M.S.F. DESALINATIO PLANTS,
SWCC Al-Khobar Desalination Plant (Sa Arabia).
A. M. Omar.
Desalination, Vol. 45, p 65-76, 1983. 5 Fig, 4 Tab Ref.

Descriptors: *Desalination, *Computer mode *Simulation, Salinity, Water temperature, S water, Mathematical models, Al-Khobar, Sa Arabia.

A simulation program for modeling MSF desali tion plants can be used to either design or simula plants in actual operation. The desired relatio ships for the formulation of a mathematical mo consist of standard chemical engineering relatio ships: material balances, energy balances, mome tum balances, kinetic relationships, equilibrium lationships, and control relationships. The math matical model developed was translated into Fortran IV computer program SWEDC for t design or simulation of MSF desalination plan with the aid of an IBM 370 computer. The pr gram outputs or results consist of the various c culated process parameters, including condens surface area of the various plant sections, proce pump heads, and basic stream flow rates. Conve gence of solution is based upon a thermodynam cally feasible solution. Application of the progra to desalination plant designs showed excellent r sults. Application of the simulation mode of t program to Al-Khobar (Phase-I) MSF desalinatio plant indicates that the original plant productio cannot be obtained due to the difference betwe the actual sea water salinity (56,000 ppm) and th reported by the project consultant (50,000 ppm and the influence of high summer sea water ten peratures (35 C). (Moore-IVI)
W84-02034

COMPARATIVE STUDY BETWEEN VAPO COMPRESSION AND MULTI EFFECT BOIL ING DESALINATION SYSTEMS,
King Abdulaziz Univ., Jeddah (Saudi Arabia) Dept. of Thermal Engineering.
M. A. Darwish, K. A. Fathalah, and S. E. Aly.
Desalination, Vol. 45, p 77-80, 1983. 4 Fig.

Descriptors: *Desalination, *Vapor compressio *Multi-effect boiling, Thermodynamics, Costs.

The following arrangements are considered: a multi effect vapor thermocompression (VTC); b multi effect boiling (MEB); c. a hybrid multi-effec boiling/vapor thermocompression. The variation of the thermodynamic properties of water are com puted using special subroutines. Using an ejector t perform the compression of the entrained vapor i considered to be a low efficiency process due t irreversibilities encountered in the entrainment mixing, and compression process. The advantage of using the ejector is that it acts as a controllin device, influenced by the following parameters total temperature difference between the hot and cold ends of the plant, concentration ratio of the brine and its effect on the boiling point elevation, number of effects, temperature difference across the condenser evaporator units. Using ejectors over the same total temperature difference would result in a reduction of the number of effects used in a conventional MEB without a proportional reduction in the plant productivity, which would lead to a reduction in the capital and running costs for pumping power. For specific temperature dif-ference, this arrangement could be beneficial for small capacities since a smaller number of effects would require less maintenance and gives more

characteristics. The hybrid arrangement include the advantages of both MEB and Moore-IVI)
2035

CATION OF THE MULTI-EFFECT ESS AT HIGH TEMPERATURE FOR E SEAWATER DESALINATION TS,
Internationale de Dessalement, Paris e).
quelin, F. Murat, and C. Temstet.
ation, Vol. 45, p 81-92, 1983. 3 Fig, 2 Tab, 2

otors: *Desalination plants, *Multi-effect , Energy, Costs, Salinity, Water tempera- awater, Arabian Gulf.

e sea water desalination plant, using the ffect process at high temperature is de- and compared with the other distillation es. The multi-effect plant is easily adaptable ide range of operating conditions. It has a al energy consumption (8.75 KWh per cu m ed), and a high GOR is obtained (12.4). red with a MSF of the same production y, the investment costs are smaller. This o a substantial decrease in cost of the pro- water. The technology of horizontal l tubes is a proven one and has been execut- re than a hundred times on small and n units. The multi-effect plant is applicable er the seawater salinity and temperature. important in areas such as the Arabian Gulf, the salinity may be 50 g/kg and the temper- ay be 5 C. Separate feed of each cell allows odulation of the brine salinity, permitting zation of seawater pretreatment. High water can be easily produced even from er with high salt content. (Moore-IVI)
2036

UTER SIMULATIONS OF MULTIPLE- T FFE-VC SYSTEMS FOR WATER DE- ATION,
nst. of Tech. (Sweden). Dept. of Chemical ering.
ation, Vol. 45, p 119-131, 1983. 5 Fig, 4 Ref.

otors: *Desalination apparatus, *Multiple- falling film evaporator, *Vapor compression, tion, Energy, Costs.

nt configurations for multiple-effect falling vaporators (FFE) and vapor compression ystems were simulated. For multiple-effect ystems, the number of effects were varied to 21. For VC systems, different locations compressor were studied. A plant with a y of 6790 cu m/day (1 MGD) was chosen. g surface of evaporators and preheaters, temperature, temperature difference in each tube length and liquid load are process eters which were investigated. Performance for the multiple-effect FFE configurations l to be low, which may be due to the use of n tubes in these simulations. The 15 effect uration had the minimum water cost. For C systems, the economy of size is very im- t in designing a feasible system. Of the three onfigurations, the configuration with the essor operating across one FFE effect shows tly lower unit water cost. For a capacity of D, and optimum evaporation area of 4500 sq ngle stage centrifugal compressor operating i = 1.19 and a total energy requirement of W will be needed. Sensitivity analyses show or energy conservation, the highest brine rature should approach 120 C and the evapo- with an optimum tube length of 7 m, should erated at a high liquid load. (Moore-IVI)
2037

ATING EXPERIENCE OF DESALINA- UNITS IN SCHEVCHENKO,
Baranov, N. A. Kabluchko, P. K. Lebedev, Samarkin, and A. P. Egorov.
Desalination, Vol. 45, p 167-174, 1983. 5 Ref.

Descriptors: *Desalination plants, *Shevchenko, USSR, Nuclear powerplants, Seawater, Potable water, Feedwater.

Shevchenko is the only town in the USSR using only artificially prepared potable water, the main component of which is distillate produced from seawater. Desalination units of three types have been built in Schevchenko and operated at the atomic thermoelectric fast reactor plant. Four and five stage concurrent units with natural circulation of solution had a limited number of evaporation stages because of the necessity of ensuring a temperature drop of no less than 10-12 C per stage for normal operation. At start-up, the units are inert, and a long time is needed to produce stable conditions. The 10-stage concurrent unit with forced brine circulation is more economical in heat consumption, and has good stability and smooth operation. The distillate produced can be used to feed steam generators of electric power stations without additional treatment. The 34-stage flash unit is easy to operate, compact and similar to the 10-stage unit in heat consumption. It is very sensitive to environmental disturbances, and the distillate produced is not applicable to feed steam generators. It is not compatible with scale prevention by means of seed crystals. The 34-stage unit has a narrow range of possible output variation, 80-100%. The 10-stage evaporation units have been chosen to extend the Shevchenko desalination complex. They are reliable in operation and give a distillate of 0.5-2.0 mg/l salt content. (Moore-IVI)
W84-02038

RELIABILITY ASSURANCE SURVEY - AN INITIAL STEP TOWARDS INCREASED OPERATING RELIABILITY AT EXISTING DESALINATION FACILITIES,
Kuljian Corp., Melbourne, FL. Desalination Div.
R. E. Bailie.
Desalination, Vol. 45, p 185-194, 1983. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Desalination plants, *Maintenance, *Computers, *Reliability, Middle-East, Statistical methods, Planning.

Over the next few years a large number of new MSF units will be added to the current installed capacity of desalination facilities in the Middle-East. There will be an ever increasing need to achieve optimum utilization of the maintenance personnel while insuring the operating reliability of these facilities over the long term. The Reliability Assurance Survey offers a step-by-step procedure which utilizes proven reliability engineering methods to initially evaluate and later predict the reliability of all critical subsystems and components within an existing facility. The procedure begins with the collection and analysis of historical data to develop a data base, followed by a computerized manipulation of this data to define the most critical subsystems and components. Systematic methods and statistical techniques are utilized to predict the reliability of these critical subsystems and components. With the aid of a microcomputer system, the data base can be continuously up-dated and the maintenance planning staff can be provided with sufficient information to predict the reliability or failure of all critical subsystems and components. A criticality analysis can focus upon those most critical components which may be candidates for a condition-based maintenance program which would use on-line diagnostics to continuously monitor the condition of the major down-time sources. (Moore-IVI)
W84-02039

PARAMETRIC STUDY ON SEAWATER REVERSE OSMOSIS DESALTING PLANTS,
Bechtel National, Inc., San Francisco, CA. Research and Engineering.
R. Soo-Hoo, L. Awerbuch, S. May, M. Mattson, and S. Kremen.
Desalination, Vol. 46, p 3-15, 1983. 9 Tab, 1 Ref.

Descriptors: *Desalination, *Reverse osmosis, Membrane processes, Seawater, Cost analysis, Automation, Energy recovery, Intakes, Site selection.

A comprehensive parametric technical and economic study of seawater reverse osmosis desalination plants was undertaken. The objective was to derive updated costs for plants ranging from 100,000 gpd to 5 million gpd at a Caribbean site and at a continental US site. The study considered hollow-fiber and spiral-wound membranes in one- and two-pass configurations, various seawater intakes (surface, seawater well, Panney collectors), various high pressure pumping systems (centrifugal, positive displacement), optional energy recovery systems (Pelton wheel, hydroturbines, workflow exchangers), and operation and maintenance labor requirements. Other variables included in the study were reduced operating pressure, extended membrane life, higher recovery ratio, improved pumping and energy recovery system efficiency, and increased plant automation. To obtain the lowest cost product water in seawater reverse osmosis, one of the key decisions in the RO plant design is the selection of the site and the intake system suitable for the local hydrogeology of that site. Intake selection is important because of its impact on the degree of pretreatment required for proper plant operation and the resulting product water economics. (Baker-IVI)
W84-02077

DESALINATION OF WATER IN SAUDI ARABIA BY REVERSE OSMOSIS, PERFORMANCE STUDY,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
C. K. Wojcik.
Desalination, Vol. 46, p 17-34, 1983. 6 Fig, 5 Tab, 3 Ref.

Descriptors: *Desalination, *Reverse osmosis, Saudi Arabia, Salbukh, Buwayb, Jeddah, Maintenance, Performance evaluation, Costs, Salinity, Seawater.

The performance of major reverse osmosis plants in Saudi Arabia is reviewed in terms of their actual productions, maintenance problems, water recoveries, quality of products and their cost. The operating experiences with these plants have ranged from marginal to excellent. Most of the problems encountered were related to the following concerns, either singly or in combination: harsh conditions in which these plants had to operate, inadequate pretreatment of water, lack of trained operators, lack of preventive maintenance, as well as designs that did not take into consideration these factors. The plants discussed were at Salbukh, Buwayb, and Jeddah. Whether the process with present membrane technology can be successful in desalination of Saudi Arabia's seawaters still remains an open question. Thus far such experience has been limited to the Red Sea where salinity rarely exceeds 42,000 ppm. (Baker-IVI)
W84-02078

DESALINATION BY REVERSE OSMOSIS IN CHINA,
W. Ying.
Desalination, Vol. 46, p 35-40, 1983. 8 Fig, 1 Ref.

Descriptors: *Desalination, *Reverse osmosis, *China, Water reuse, Water supply development, Membranes.

Research is described concerning desalination by reverse osmosis (RO) and water reuse in China. RO desalination research began in China in 1967 with the first ten years being devoted to translation of foreign papers on the subject into Chinese. From 1977-1980 rapid progress was made in the area of membrane research. Two kinds of aromatic polyamide hollow fiber and a kind of honeycomb dynamic formed membrane module and desalination equipment were developed. In recent work much of the emphasis has been aimed at solving RO theoretical questions and problems that arise during practical application of the technique. Problems currently being researched include the development of materials for membranes for special purposes, development of chemical products, and shortening of the cycle of production. Steps are being taken to increase the testing period of RO

service life before producing the equipment, to select good plants for manufacturing RO equipment, to pay great attention to the equipment used in the pretreatment process and increase the investment for pretreatment to 1/4 to 1/3 of the total budget, and to train accomplished operators. (Baker-IVI)
W84-02079

EXPERIENCE WITH DESALINATION OF SEA AND BRACKISH WATER USING MINIMUM PRETREATMENT AND HIGH TEMPERATURE,
Danske Sukkerfabrikker, Nakskov. Reverse Osmosis Div.
W. K. Nielsen.
Desalination, Vol. 46, p 67-79, 1983. 6 Fig, 6 Tab, 8 Ref.

Descriptors: *Desalination, *Membranes, Membrane processes, Seawater, Brackish water, Reverse osmosis, Costs.

In 1980 a new thin film composite membrane was introduced. This membrane can operate at high temperatures in the range of 0-80 C. Cleaning can be performed with acid and alkaline chemicals in a pH range of 1-12.5. The HR95/98 membranes in the plate-and-frame configuration give a combination which has proven to be extremely dependable. Multi-media filtration and security screens are frequently satisfactory as pre-treatment. Depending on the composition of the water, chemical additions are reduced compared to conventional reverse osmosis operation. The plants are designed as continuous plants with recirculation which has proved to give high security of operation and a high degree of flexibility in operating range. Compared to desalination with cellulose acetate membranes the new technology offers several advantages amongst which membrane stability, plant security against failures, reduce chemical and pretreatment costs and safe operation are the most predominant. (Author's abstract)
W84-02080

TEST RESULTS ON FT-30 EIGHT-INCH-DIAMETER SEAWATER AND BRACKISH WATER REVERSE OSMOSIS ELEMENTS,
FilmTec Corp., Minneapolis, MN.
R. E. Larson, R. J. Peterson, and P. K. Eriksson.
Desalination, Vol. 46, p 81-90, 1983. 4 Fig, 11 Ref.

Descriptors: *Desalination, *Reverse osmosis, Membrane processes, Seawater, Brackish water, Membranes.

Spiral-wound reverse osmosis elements formed of FT-30 membrane have been used for a variety of desalting applications around the world. The membrane was originally developed to satisfy the requirement for a true single-pass seawater membrane that would maintain its salt rejection characteristics while operating in a variety of seawater feeds. Later test results proved its applicability as a brackish-water desalting membrane as well, and FT-30 elements are now operating over a broad spectrum of feedwaters, ranging from tapwater to difficult industrial separations. The FT-30 membrane is noncellulosic and is of a thin-film composite configuration. It satisfies the main requirement of having high flux and excellent salt rejection, but in addition it is chemically stable, can operate over a broad range of pH, is partially resistant to chlorine exposure and shows good stability at high feedwater temperatures. These latter characteristics facilitate both acid and caustic cleaning, an important consideration under fouling conditions. Considerable field application experience has been obtained with FT-30 membrane elements over the past three years. This experience has given excellent results, although it has been limited to small elements - the largest manufactured by FilmTec until recently was 4 x 21 inches and gave 600 gpd on seawater and 1200 gpd on brackish water. In early 1982 4 x 40-inch elements began to be produced and used commercially. Then in the summer of 1982, 8 x 40-inch elements were manufactured for the first time, meeting the design goals of single-pass seawater performance with product flows of over 5,000 gpd, and under brackish water conditions with flows of over 10,000 gpd. These large elements are now being tested on seawater and brackish water feeds in the Mid-East, in England, in Florida, and in several other locations. Single-pass seawater performance data and brackish-water test results are presented. Eight-inch elements are now being produced in commercial quantities for use in large reverse osmosis installations. (Author's abstract)
W84-02081

ULTRAFILTRATION MEMBRANE PROCESSES - THE SLEEPING GIANT,
RQ Associates, Inc., Teaneck, NJ.
R. M. Quinn.
Desalination, Vol. 46, p 113-123, 1983. 9 Fig.

Descriptors: *Desalination, *Membrane processes, Ultrafiltration, Filters.

Ultrafiltration processes and systems are reviewed and evaluated. Hollow fiber, spiral wound, and tubular systems and their relative process and cost advantages are reviewed. The effects of process parameters such as foulants in feed water, temperature, operating pressure and flux on process design and system configuration are considered. The paper can serve as an introduction to ultrafiltration for those who are not yet familiar with the technology. The ability of current membranes to treat a variety of streams, and the need for purer products and more effective concentration/separation processes are creating a renewed interest in the field. (Baker-IVI)
W84-02082

DESALINATION OF HIGH SALINITY SEA WATER BY REVERSE OSMOSIS (SUMMARY),
Water Reuse Promotion Centre, Tokyo (Japan).
Y. Kunisada, K. Okada, M. Tsureish, K. Kikuchi, and M. Hirai.
Desalination, Vol. 46, p 145-150, 1983. 2 Fig.

Descriptors: *Desalination, *Seawater, *Reverse osmosis, Water temperature, Salinity.

Performance tests were carried out on three new reverse osmosis modules for single pass desalination of high salinity and high temperature seawater, developed by Japanese manufacturers. Experiments were carried out on HR5350S module under the conditions of feed water salinity 42,000 mg/l, feed water temperature 40 degrees C, operating pressure 54 kg/sq cm and recovery ratio 30% for 3,000 hours, on SP-210 module under the conditions of feed water salinity 42,000 or 50,000 mg/l, feed water temperature 35 or 40 degrees C, operating pressure 56 or 63 kg/sq cm and recovery ratio 35-25% for 4,260 hours and on SP-110X module under the conditions of feed water salinity 50,000 or 55,000 mg/l, feed water temperature 30 or 35 degrees C, operating pressure 63 kg/sq cm and recovery ratio 25-21% for 1,640 hours. TDS of the product water were about 200 mg/l, less than 200 or about 250 mg/l and 210-220 mg/l respectively. Each module showed stable performance. (Author's abstract)
W84-02083

SOLUTION OF CONTRADICTORY PROBLEM OF SIMULTANEOUS DESALINATION AND CONCENTRATION IN REVERSED OSMOSIS,
C. A. Yagodin, B. F. Nikolsky, N. F. Kuleshov, and A. A. Svitsov.
Desalination, Vol. 46, p 171-177, 1983. 3 Ref.

Descriptors: *Desalination, *Reverse osmosis, Sea water, Brines, Water supply, Desalination wastes.

The optimum relation must be established between the volumes of water and brine, when the reverse osmosis process is used to desalinate and purify water. A method of calculation of the optimum relation for reverse osmosis units takes into account the inconsistency of the task of simultaneous desalination and concentration of salt solutions. In testing the procedure it was determined that the method permitted a reduction in the volume of wastes discharged from reversed osmosis units to the environment. By developing the flow sheets of reverse osmosis units using the derived depen cies it was possible to calculate the cross secti area of the membrane apparatus along the path solution being separated. It was possible to ca late the capacity and quality of permeate in section, the degree of concentrating in the w unit and its individual parts. (Baker-IVI)
W84-02084

DESIGN AND FIELD TRIALS OF A 200 CU DAY SEA WATER DESALINATION BY EL TRODIALYSIS,
National Bureau of Oceanography, Hangz (China). Second Inst. of Oceanography.
S. Shi, and P.-Q. Chen.
Desalination, Vol. 46, p 191-196, 1983. 2 Fig Ref.

Descriptors: *Desalination, *Electrodialysis, Wa supply development, Membrane processes, Chi Meishan Island.

A 200 cu m/day sea water desalination plant us electrodialysis has been developed. The plant c sists of ten stages divided into two groups, mo fied on the basis of the plant containing twel stages with three groups. Ruthenium-coated tita um wire electrodes are used for anode and ca ode, electrode compartments are rinsed by hi velocity and electrode polarity is reversed perio cally, so the plant does not need any acid duri operation. Field trials on the first and the modifi plants were carried out for 1500 and 350 hou respectively on Meishan Island along the coast Zhejiang Province in 1978 and 1979. The perfor ances of both plants have been proved to be stab but the latter is more simple and more economic than the former one. The water produced must sterilized if it is to be used for drinking purpose (Baker-IVI)
W84-02085

ADSORPTION - DESORPTION STACK FO CYCLIC ELECTRODIALYSIS IN OPE SYSTEM,
M. E. Abu Goukh, and D. W. Thompson.
Desalination, Vol. 46, p 211-223, 1983. 8 Fig, Tab, 9 Ref.

Descriptors: *Desalination, *Electrodialysis, Sca ing, Membrane processes, Cyclic electrodialysis Scaling.

The main problems encountered in conventiona electrodialysis, ED, are reviewed. Cyclic electro dialysis is proposed as an attractive alternativ with ability to circumvent the main problems i the standard unidirectional process; namely, th scale formation and membrane fouling. The mai design and operation features of cyclic electrodia lysis are discussed and compared with those o conventional electrodialysis. Design and operatin features of an adsorption-desorption stack which i suitable for cyclic electrodialysis are presented Stack capability has been demonstrated using aque ous sodium chloride solution under different oper ating conditions of feed concentration, production rate, applied voltage, cycle timing and demineraliz ing path length. A separation factor as high as 65 was obtained in an open system, while separation factors of the order 1000 had been obtained in a closed system. (Author's abstract)
W84-02086

CHARACTERISTICS OF FLOW AND MASS TRANSFER RATE IN AN ELECTRODIA-LYZER COMPARTMENT INCLUDING SPACER,
Hitachi Research Lab., Ibaraki (Japan).
O. Kuroda, S. Takahashi, and M. Nomura.
Desalination, Vol. 46, p 225-232, 1983. 11 Fig, 5 Ref.

Descriptors: *Membrane processes, *Desalination, *Ion exchange, Mass transfer, Flow rate, Electrodialysis.

In order to determine the optimum compartment structure and operation conditions for electrodialy-

e hydraulic characteristics and mass transfer
ting ability of net-type (mesh) spaces insert-
a compartment were investigated. The rela-
etween spacer structure and these two char-
tics were examined in experiments through
ctrochemical reaction of the redox system.
en the fluid friction coefficient and Reynolds
r the relation was established with channel
ls, the gaps between spaces and channel
and mesh size. Mass transfer promotion
teristics were measured electrochemically.
pacers with larger mesh showed a higher
tion effect at relatively low pressure loss for
nt channel intervals. This demonstrated that
effective spacers could be developed by ad-
the mesh sizes. Temperature variation of
ransfer coefficients obtained coincided with
rature variations of the limiting current den-
r electrodialysis. (Baker-IVI)
2087

**IGES IN WATER AND SALT TRANS-
DURING HYDROLYSIS OF CELLU-
ACETATE REVERSE OSMOSIS MEM-
ES,**
rnia Univ., Los Angeles.
er, and S. McCray.
nation, Vol. 46, p 389-397, 1983. 4 Fig, 2
0 Ref.

ptors: *Desalination, *Cellulose acetate
ranes, Membrane processes, Reverse osmo-
ater transport, Permeability coefficient, Hy-
is.

ose acetate membranes undergo hydrolytic
position which is accelerated at very high or
H levels. Hydrolysis results in the loss of
groups leading to a sharp decline in mem-
performance. Minimum hydrolysis rates
in the pH range of 4-6. The two parameter
ort equation gives salt and water permeabil-
fficients which depend on membrane acetyl
t. In this paper both coefficients, calculated
erformance changes are shown, to increase
entially with time. Rate constants calculated
hese changes show changes in salt perme-
to be an order of magnitude greater than
es in water permeability. The observed dis-
cy in salt and water transport kinetics sug-
iffering mechanisms for these two processes.
ntly, salt-water coupling during transport in-
s as membrane hydrolysis progresses. Thus,
vo parameter transport equations do not
since they neglect the salt-water coupling
menon. The use of other membrane trans-
nodels to account for changes in membrane
mance as hydrolysis occurs is discussed. The
n between acetyl content and hydrolysis
also considered. (Baker-IVI)
2089

**LINATION PLANT PROGRAM TO
E SHORTAGE OF WATER IN THE
HERN ITALIAN ISLANDS (SICILY),**
per il Mezzogiorno, Rome (Italy).
nsiglio, and M. Creton.
nation, Vol. 45, p 209-220, 1983. 8 Tab.

iptors: *Desalination plants, *Management,
Italy, Water supply, Contracts.

iginal form of contract is presented which
les a single call for tenders for installing six
nation plants in some small islands of Sicily
nds the contractor to the possible operation
the plants concerned for an eleven year
. The use of water desalination plants is the
method of supplying enough water for sev-
f the small Sicilian islands. The main choices
in implementing the desalination plant pro-
consist of entrusting the contractor with the
ion of the desalination plant for a consider-
ng time of up to 11 years, arranging a single
covering all the desalination plants on a
ey basis, or giving the companies the choice
ect the kind of desalination processes. Once
nder has been established, the goals of the
were set as follows: comprehensive bids for
, supply and installation of six desalination
, with relative power generating stations and
civil works; comprehensive bids for the operation of all the plants and auxiliaries for the first year following acceptance of the plant; and the committment to operate the desalination plants and auxiliaries for a further 10 year period with coverage of any expenditure needed for maintenance and operation. (Baker-IVI)
W84-02090

DESIGN AND PERFORMANCE OF THE WORLD'S LARGEST OPERATING DUAL-PURPOSE SEA WATER DESALTING PLANT,
INCON Anlagentechnik G.m.b.H., Homburg/Saar (Germany, F.R.).
F. G. Abbosh, I. Kamal, S. Chalchal, and H. Gerke.
Desalination, Vol. 45, p 223-230, 1983. 2 Fig, 2 Tab.

Descriptors: *Desalination, *Water treatment facilities, Water supply development, Water shortage, Saudi Arabia, Jeddah, Scaling, Corrosion, Powerplants, Chlorination, Control systems, Seawater.

The 500 MWe/220,000 cu m/day Jeddah 4 Power and Desalination Plant is the largest operating dual-purpose plant in the world. It was needed in Saudi Arabia to meet the growing water and power requirements of the Jeddah area. The plant is based on 5 boilers and turbogenerator sets, each producing 100 MW net electrical power. A novel feature of Jeddah 4 is its sophisticated instrumentation, control and computer system which provides for complete central operation and control from the main control room. All these systems are designed for fail-safe operation, and plant availability is assured by provision of manual control back-up for all major plant items. Owing to adequate control of tube-fouling and low non-equilibrium losses, performance ratios are 10 to 20% better than design. Production levels are 10% above design, with steam consumption below the design values. Scale control has been based on dosing with sulfuric acid at less than the stoichiometric amount, leaving a residual alkalinity of about 10 ppm in the make-up feed. The seawater feed to the Jeddah 4 plant is continuously dosed with chlorine at a rate of 2 ppm. During early stages of operation a gradual loss in vacuum was observed after the 4 stage ejector/barometric condenser system had been in operation of 6-10 hours. External and internal corrosion of stainless steel pipes, aggravated by the aggressive ambient atmosphere and possible contact with stagnant sea water was noted and corrected. (Baker-IVI)
W84-02091

THERMAL DESALINATION OF SEA WATER IN THIN FILM PLANTS,
Dalnevostochnyi Politekhnicheskii Inst., Vladivostok (USSR).
V. N. Slesarenko.
Desalination, Vol. 45, p 295-302, 1983. 4 Fig, 6 Ref.

Descriptors: *Desalination plants, *Seawater, *Thin films, Heat exchangers, Hydrodynamics, Desalination, Entrainment, Scaling.

A further improvement of desalination plants calls for finding new ways on intensification of their working process. This can be achieved by using heat exchangers with thin film liquid supply in the flow sheet of a plant, the apparatus being characterized by a high-efficiency heat exchange. Hydrodynamics and heat exchange were investigated in desalination plants in which a liquid is fed to the heating surface due to rising entrainment of film by a hot air flow and free washing of a horizontal surface. The intensity of heat exchange in horizontal and rising film heat exchangers are 2-3 times higher than in the other types of desalination plants. Temperature differences are rather low, which prevents scale formation on the heating surface. The coefficients for sea water are 15-20% higher than those for distillate, confirming the conclusion about the impossibility of using data obtained on distillate and single component brines in design methods. (Baker-IVI)
W84-02092

INVESTIGATION OF WATER DESALINATION BY DISTILLATION TECHNIQUE,
N. M. Sinev, V. G. Shatsillo, V. B. Chernozobov, A. A. Samarkin, and Ju. S. Baranov.
Desalination, Vol. 45, p 315-320, 1983. 1 Tab.

Descriptors: *Desalination, *Distillation, Evaporation, Scaling, Corrosion control, Shevchenko, USSR.

The main large stationary desalination units of different types developed in the USSR and used in the design of the largest plant in Shevchenko having the output of 100000 cu m/day of distillate is described. The plant operates in close interrelation with an atomic thermoelectric 5H-350 fast reactor plant and back pressure turbines. Some results of constantly performed studies into heat transfer, vapor separation, control of scale deposits and corrosion are discussed along with results of searching for new thermal systems and instruments to be used for the improvement of operating distillation desalination units and the development of new ones. Further prospects of thermal desalination are associated with the use of multi-stage units equipped with horizontally arranged tube film evaporators. (Author's abstract)
W84-02093

DESALINATION PLANT CONTROL WITH MICROPROCESSOR BASED DIGITAL TECHNOLOGY,
Honeywell Europe S.A., Brussels (Belgium). Process Management Systems.
G. O. Hultin, and R. Harper.
Desalination, Vol. 45, p 329-336, 1983. 4 Fig, 1 Ref.

Descriptors: *Desalination plants, *Corrosion control, *Digital computers, Microprocessors, Computers, Automation.

The success of improved control strategies for minimizing corrosion and for improving plant operation efficiency is dependent on the data acquired from the process. To obtain improvements in control, more data than is now generally available will have to be collected. Distributed microprocessor based digital technology with a hierarchical system approach provides effective tools for on-line corrosion control by making use of the available historization, trending and alarming features. The hierarchical system structure facilitates improved production efficiency at different levels of sophistication, from a basic control concept to an automatically optimized operation by making use of thermodynamical steam and water properties. A high level of reliability is reached through this system structure, making costly solutions with redundant computers unnecessary. (Author's abstract)
W84-02094

RECENT SOLAR DISTILLATION DEVELOPMENTS,
A. Delyannis, and E. Delyannis.
Desalination, Vol. 45, p 361-369, 1983. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Desalination, *Water supply, *Solar distillation, SOLERAS Project, Potable water, Distillation, Rain, Wind energy, Arid areas.

In arid areas rain is often collected and stored to be used as fresh water supply over the year. Solar distillation may provide potable water for remote locations where other water supply systems are not available. Since the intensity of solar radiation per unit of evaporating area is determined by nature, the output of a solar distillation unit in a given location can only be increased by increasing the evaporating surface. Solar distillation can never be a steady operation due to changes in intensity of the sun during the day. There are two ways of increasing the fresh water yield in connection with standard greenhouse distillation units. The first is rain collection. The second way of increasing the efficiency of conventional greenhouse type solar stills is to use preheated water or waste hot water as the feed. Use of more effective desalination

processes of proven technology, instead of conventional greenhouse type solar distillers, results in higher efficiencies. Direct or indirect utilization of solar energy may also be combined with other desalination processes, without necessarily having the production of hot water as intermediate stage. Wind energy to produce electricity or photovoltaics may be combined with reverse osmosis or electrodialysis. (Baker-IVI)
W84-02095

DESALINATED WATER PRODUCTION AT LNG-TERMINALS,
Nuovo Pignone S.p.A., Florence (Italy).
A. Antonelli.
Desalination, Vol. 45, p 383-390, 1983. 2 Fig.

Descriptors: *Desalination, *Fuels, *Liquefied natural gas, Natural gas, Sea water, Thermodynamics, Freezing.

A process has been worked out to apply the laws of thermodynamics to sea water desalination making use of liquefied natural gas (LNG). Ambient temperature heat is applied to LNG which evaporates and generates power. This power is employed to extract heat from sea water, part of the sea water is frozen and the heat is discharged to the environment. The ice produced is melted at ambient temperature and desalted water is obtained. Conventional technology is used for every component of a plant using this method. This type of plant may produce quite a substantial amount of desalted water, up to 3.2 tons of water per ton of LNG. Therefore a terminal capacity of 5,100,000,000 NM3/yr of natural gas may produce 10,000 t/d of water, equivalent to the needs of a town of 40,000 inhabitants. (Baker-IVI)
W84-02096

REVERSE OSMOSIS MEMBRANE SENSITIVITY TO OZONE AND HALOGEN DISINFECTANTS,
California Univ., Los Angeles. Dept. of Chemical, Nuclear, and Thermal Engineering.
J. Glater, M. R. Zachariah, S. B. McCray, and J. W. McCutchan.
Desalination, Vol. 48, p 1-16, 1983. 10 Fig, 3 Tab, 13 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Disinfectants, Membranes, Ozone, Chlorine, Iodine, Cellulose acetate membranes, Polyamides, Bromine, Hydrogen ion concentration.

The sensitivity of commercial reverse osmosis membranes toward halogen and ozone disinfectants has been measured at carefully controlled concentration and pH levels. Membrane sensitivity varies with polymer type, disinfectant chemical, and solution pH. Aromatic polyamide membranes are damaged by halogen addition to aromatic rings within the polymer. This process follows predictable reaction kinetics. Polymer viscosity changes with increasing membrane damage have also been followed. Cellulose acetate membranes are generally resistant to halogens and halogen derivatives. Polyamide type membranes are sensitive to chlorine and bromine but show reasonable resistance with appropriate pH control. Ozone will damage any membrane tested, but cellulose acetate shows some resistance at low pH levels. This type of membrane may resist low concentrations in systems designed for ozone disinfection. All membranes are generally resistant to iodine. Polyamide type membranes are generally resistant to chlorine dioxide at near neutral pH. This chemical evidently attacks membranes at high pH by oxidation since no halogen uptake is noted. DuPont B-9 membrane chemically combines with chlorine during exposure. This process is accompanied by decreasing viscosity of polymer solutions in dimethyl sulfoxide. Chlorine uptake data follows pseudo-first reaction kinetics. (Baker-IVI)
W84-02097

SHORT CUT DESIGN METHODS FOR REVERSE OSMOSIS SEPARATION WITH TUBULAR MODULES,
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Chemistry and Chemical Engineering.
K. K. Sirkar, and G. H. Rao.
Desalination, Vol. 48, p 25-42, 1983. 2 Tab, 14 Ref.

Descriptors: *Desalination, *Reverse osmosis, Turbulent flow, Mathematical equations.

The basis for obtaining explicit flux expressions in reverse osmosis separations with concentration polarization has been illustrated for tubular modules with turbulent flow. Various analytical equations developed thereby to predict the required number of tubes and the permeate solute concentrations are described and compared with one another as well as with the currently used numerical methods. The utility of such simple design procedures are pointed out. The possibilities and difficulties of adopting these procedures for designing spiral-wound modules have been discussed. The analytical equations can be adopted to 'tapered-flow' reverse osmosis without much difficulty. (Author's abstract)
W84-02098

POLYPIPERAZINAMIDES: NEW POLYMERS USEFUL FOR MEMBRANE PROCESSES,
Istituto Guido Danegani S.p.A., Novara (Italy).
P. Parrini.
Desalination, Vol. 48, p 67-78, 1983. 14 Fig, 5 Ref.

Descriptors: *Desalination, *Membranes, Membrane processes, Polypiperazinamides, Polymers.

A class of polymers based on piperazinamides is described. The structures and physical properties of main polymers are compared and the osmotic performance is examined. Among the polymers considered, the trans-2,5-dimethylpiperazinthiofurazan 3,4-amide was developed as a precursor for reverse osmosis. The osmotic properties of asymmetric membranes obtained from TFZ amides are reported. The resistance to temperature, to variations in pH and to chlorine and its derivatives are of great interest. This type of membrane assembled in different modules, is used in the desalination field as well as in other technological processes such as fluid treatment, the oenological field, and materials recovery. At present, 50 to 100 cm wide polypiperazinamide membranes are produced commercially. They are prepared on textile supports, so as to make their utilization in preparing spiral modules easier. (Baker-IVI)
W84-02099

PREVENTION OF CALCIUM SULFATE SCALE DEPOSITION BY A FLUIDIZED BED,
Technische Hogeschool, Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
J. A. M. Meijer.
Desalination, Vol. 47, p 3-15, 1983. 12 Fig, 15 Ref.

Descriptors: *Desalination, *Distillation, *Fluidized beds, *Scaling, Calcium sulfate, Seawater, Brackish water, Fouling, Evaporators, Hemihydrate, Anhydrite.

The scale inhibiting capability of a fluidized bed in the vertical heat exchanger tubes of a Multi Stage Flash/Fluidized Bed Evaporator (MSF/FBE) was investigated. The MSF/FBE is a vertical flash evaporator used for the distillation method of converting sea and brackish water into fresh water. This method possesses excellent features with respect to investment costs, specific heat consumption and prevention of fouling and scaling. The temperatures at which calcium sulfate scale starts to deposit despite the abrasive action exerted on the wall by fluidized bed particles was determined. In all experiments the calcium sulfate hemihydrate solubility line could be exceeded to a certain extent without scale deposition. At concentration factors of sea water larger than 2.5 hemihydrate was found, while at lower concentrations factors anhydrite was deposited. The highest top temperatures were reached when the brine was deaerated and recirculation of seeding crystals was excluded. Scale deposition is prevented more efficiently by 2 or 3 mm glass particles than by 1 mm glass particles. A model is given to describe the competitive processes of scaling and abrasion at the wall of the heat exchanger tubes. Both processes were studied separately. The removal rate of calcium sul crystals were determined by abrasion tests experiments in a scaled up fluidized bed, and growth rate of calcium sulfate by experiments high temperature rotating disc reactor. (Baker-I W84-02100

APPLICATION OF A HIGH TEMPERATU SCALE CONTROL ADDITIVE IN A MIDD EAST MSF PLANT,
Nalco Italiana S.p.A., Rome (Italy).
G. F. Casini.
Desalination, Vol. 47, p 19-24, 1983. 5 Fig.

Descriptors: *Desalination, *Scaling, *Corro control, Nalco 8599-NI, Distillation, Seawa Evaporators, Crystallization, Water temperatu

A new antiscale product, Nalco 8599-NI, w tested for its effectiveness in a sea water evapo tor located in the South-East end of the Ara peninsula, operating with Gulf water. The inhi tor incorporates a specific dispersant agent, is s plied in liquid form and is miscible with sea-, fre or distilled water at any proportion. Nalco 8599-I is effective as regards growth of both crystalli tion nuclei and pre-existing crystals in that double layer of electrical charges is created. In t first case, a distortion of the crystallograph growth plans occurs and the growth of the micr crystal is inhibited. In the second case, the doub electric layer has a dispersant action and the cry tal, therefore, will no longer originate scale. T altered structure and the strong dispersive acti allow the particles to be easily transported fro the system at normal flow rates. The Nalco 859 NI proved effective at 7 ppm at a brine temper ture of up to 110 degrees C. The product was al shown effective at 5-6 ppm for the same temper ture level. Lower dosages may be used when th top temperature of the brine is less than 110 d grees C. (Baker-IVI)
W84-02101

SCALE CONTROL INHIBITOR PERFORM ANCE AT 100 DEGREES C UNDER BOILIN CONDITIONS,
Mechanical Equipment Co., New Orleans, LA
R. W. Goeldner.
Desalination, Vol. 47, p 25-35, 1983. 3 Fig, 4 Ref

Descriptors: *Desalination, *Scaling, Distillation Corrosion control, Additives, Temperature.

Trials were conducted using commercially avail able high temperature threshold additives with packaged vapor compression distiller to study the performance of these chemical in distillation plants which operate with boiling brine in contact with heat transfer surfaces at elevated temperatures. The vapor compression distiller uses vertical fluted tubes in an upflow natural circulation mode and operates just above atmospheric pressure. Some of the chemicals tried are those which have enabled a number of large MSF distillers to operate for thousands of hours between cleanings at terminal temperatures of over 100 C. Improvements made in chemical treatment as part of the test program have resulted in extending the time period between cleanings five fold. It is believed that these improvements can be used to make threshold type scale inhibition a practical reality in large scale high temperature multi-effect and vapor compression distillers as well as many MSF plants which have not responded favorably to conventional high temperature additives. (Baker - IVI)
W84-02102

ASSESSMENT OF DIFFERENT SCALE CONTROL METHODS,
Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
R. Rautenbach, H. Offermann, and E. E. Hammer.
Desalination, Vol. 47, p 49-62, 1983. 18 Fig, 11 Ref.

Descriptors: *Desalination, *Scaling, *Distillation, Ion exchange, Cost analysis, Additives, Cation exchange.

llation plants, operating at least partially well
e ambient temperature, must be protected
st scaling. In principle, this can be achieved
number of different processes - eight of which
xamined and assessed. These studied included
ive dosing, acid dosing, lime magnesium car-
te-process, thermal precipitation, cation ex-
ge, seeding processes, coated or polished sur-
on line mechanical cleansing and additive
g. According to a cost-benefit analysis ion
nge seems to be an interesting alternative to
ve dosing. The comparison between fixed
nd moving bed ion exchange in the range of
ities between 200 and 20000 t/d distillate
tes that moving bed ion exchange is less
taneous than a fixed bed process. This state-
is particularly valid for small and medium-
plants. At present more information is needed
rning service life time, the rate of resin-
ction within the recirculating pumps of the
g bed process, and the rate of resin-destruc-
e osmotic shock in the fixed bed process. It is
sted that a reduction of about 10% of the
ic water cost is possible if the feed of a single
se MSF plant is treated by ion exchange
d of additive dosing. It must be emphasized,
ver, that a possible reduction of this 10% is
y of the same order as the range of accuracy
cost estimate. As energy prices increase, the
on will shift in favor of the ion exchange
ss. (Baker-IVI)
02103

**UATION OF THERMAL DESALINA-
PLANTS WATER CHEMISTRY,**
larstvennyi Nauchno-Issledovatel'skii Ener-
eskii Inst., Moscow (USSR).
Martynova, L. G. Vasina, A. V. Baglovsky,
Yegorov, and L. P. Karnauknov.
nation, Vol. 47, p 63-69, 1983. 2 Fig, 1 Tab, 6

iptors: *Desalination plants, *Water chemis-
Scaling, Evaporation, Acids, Mass transfer.

major problem in desalination plant improve-
remains the development of new, more ef-
methods of optimal water chemistry re-
maintenance. Scale formation is determined
o interconnected processes: transport of
to the growing crystal surface due to con-
e mass transfer and surface reaction penetrat-
to the crystal lattice. For the purpose of
sing scale formation intensity, enclosure of a
-softener apparatus directly before the
rator stage was considered. Due to substan-
ystallization in the thermo-softener appara-
ere was a decrease of scale forming compo-
entering the evaporators. A significant redis-
on of carbonic acid components was also
with a relative increase of carbonate and
xyl ions. By monitoring scale growth regu-
during the incubation period and mass
r processes the optimal regime of acid im-
addition can be maintained. The ease of the
on, significantly lower acid input, and less-
orrosion intensity, make this method more
ing than the continuous acidification meth-
Baker-IVI)
2104

**LPHATION NEW APPLICATIONS:
EAST(KUWAIT) AND GELA (ITALY)
LINATION PLANTS,**
ni Omi S.p.A., Reggio Emilia (Italy).
noni, A. de Maio, G. Odone, F. Fioravanti,
Boari.
nation, Vol. 47, p 93-102, 1983. 5 Fig, 5 Tab,

ptors: *Desalination, *Scaling, *Desulfation,
m sulfate, Seawater, Italy, Kuwait.

sulfation treatment, designed and processed
giane under a C.N.A. patent, is an advanced
for sea water make-up treatment in MSF
ation plants. This process, applied to plants
cid treatment, avoids calcium sulfate scale
heat exchange surfaces and increases the top
emperature, with higher plant performance
Doha East-Kuwait, is designed for the treat-
ment of a make-up flow of 480 cu m/h and a top brine temperature of 138 C (280 F), and will linked up with a desalination plant (1 MIGPD), currently being built. Start-up and plant test are scheduled for the last six months of 1983. The second unit, Gela-Italy, has been projected to be annexed to one of the existing four MSF desalination plants sited in the ANIC Petrochemical Plant in Gela-Italy, to eliminate severe calcium sulfate scaling problems and to restore the projected standards actually not met. The desulfation unit will allow the treatment of a sea water make-up flow of 1200 cu m/h with a top brine temperature of 130 C (265 F). (Baker-IVI)
W84-02105

RO DESALTING OF BRACKISH WATER OVERSATURATED WITH CASO4,
Mekoroth Water Co., Tel Aviv (Israel).
M. Wilf, and J. Ricklis.
Desalination, Vol. 47, p 209-219, 1983. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Desalination, *Reverse osmosis, Brackish water, Salinity, Calcium sulfate, Cost analysis, Financial aspects.

The possibility of recovery increase in the commercial reverse osmosis plant, desalting brackish feed of 5000 ppm total dissolved solids salinity, was tested in a pilot plant equipped with 4 inch spiral wound and hollow fiber modules. The plant desalted the reject stream from the commercial plant. Long term field tests of up to 4000 hr on membrane performance were conducted. During the tests the ratio of the calcium and sulfate ion concentrations product to the formal solubilities of calcium sulfate at the corresponding ionic strength was maintained in the range of 1.2 to 2.3. Stable membrane performances were obtained with respect to productivity and salt rejection. Based on the field results a 900 cu m/d unit for reject desalting was constructed. The unit enabled an increase of the product recovery in the commercial plant to 65% from a design value of 53%. Difficulties which had been encountered in earlier long term tests such as feed component depletion and foulant accumulation during the test period were avoided by the once through flow of the feed in the experimental system. The stable performance of the membranes indicated that it would be possible to operate the commercial reverse elements at much higher concentrations of sparingly soluble salts that the safe limits accepted thus far. A substantial margin exists which can be exploited for better desalting economics. (Baker-IVI)
W84-02107

CONTROL OF BIOLOGICAL FOULING IN SEAWATER REVERSE OSMOSIS DESALINATION,
Fairleigh Dickinson Univ., Teaneck, NJ. Dept. of Biological Sciences.
H. Winters, I. Isquith, W. A. Arthur, and A. Mindler.
Desalination, Vol. 47, p 233-238, 1983. 7 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Membrane processes, Scaling, Microorganisms, Chlorination, Ferrous sulfate, Citric acid, Tannic acid, Polyacrylate, Seawater.

Various non-acid pretreatment schemes were studied in a seawater reverse osmosis desalination plant for one year. Particular attention was given to microbial aspects of fouling. Four different approaches to non-acid pretreatment were considered: chlorine starvation by the use of minimal chlorine which just satisfied the chlorine demand of the seawater coupled with ferrous sulfate coagulation and dechlorination; addition of organic antiscalant; addition of citric acid as an antiscalant; and addition of tannic acid as an antiscalant and antifoulant. Both polyacrylate and tannic acid showed some promise as an alternative to acid pretreatment and chlorination. A new assay was developed which holds promise for predicting the potential of any feed water sample to promote microbial fouling. (Baker-IVI)
W84-02108

DESALINATION OF COALMINE DRAINAGE WATER BY REVERSE OSMOSIS,
Binnie and Partners, London (England).
R. C. Squires, J. A. C. Cowan, and F. C. Wood.
Desalination, Vol. 47, p 343-350, 1983. 5 Fig, 1 Tab.

Descriptors: *Desalination, *Mine drainage, *Reverse osmosis, Ion exchange, Coal mines, Membranes, Wastewater treatment, Wastewater renovation.

A small pilot plant has been built and operated to study the treatment of a mine drainage water of bicarbonate type to render it suitable for use as boiler feed make-up or disposal. To avoid the need for excessive dosing with acid, pre-softening of the feed by ion exchange was adopted and a range of types of reverse osmosis membranes comprising tubular, spiral-wrap and hollow-fine fiber geometries was tested. Best results were obtained with thin-film composite type membranes, salt rejection of over 99% being obtained in a single-pass operation with recyle of concentrate. The preferred process also makes possible the recovery of soda ash from the minewater, after thermal concentration. (Author's Abstract)
W84-02115

3B. Water Yield Improvement

POTENTIAL FOR WATER YIELD AUGMENTATION FROM FOREST MANAGEMENT IN THE EASTERN UNITED STATES,
Southeastern Forest Experiment Station, Asheville, NC. Coweeta Hydrologic Lab.
J. E. Douglas.
Water Resources Bulletin, Vol. 19, No. 3, p 351-358, June, 1983. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Water yield improvement, *Forest management, Streamflow, Land management, Water demand, Eastern United States.

Generally high rainfall and extensive forests in the East combine to produce excellent potential for managing forests for increased water yield. Models are presented that allow prediction of streamflow increase from hardwood and pine forests on a year-by-year basis. They are being routinely applied in land management planning on National Forests in the Southeast. A recent, independent test indicates that cumulative water yield increases can be predicted within about 14% of the actual value. However, because of the diverse land ownership patterns and the economic objectives of owners, realizing the full potential appears greatest where the land is publicly owned, but demand for water in the East has not reached the point where need for water dictates management prescriptions. (Author's abstract)
W84-01920

POTENTIAL FOR WATER YIELD AUGMENTATION FROM FOREST MANAGEMENT IN THE ROCKY MOUNTAIN REGION,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
C. A. Troendle.
Water Resources Bulletin, Vol. 19, No. 3, p 359-373, June, 1983. 17 Fig, 4 Tab, 30 Ref.

Descriptors: *Forest management, *Water yield improvement, *Rocky Mountains, Cutting management, Subalpine zone, Lapine zone, Evapotranspiration, Snowpack, Forest hydrograph.

With the exception of the Sierra-Cascade mountain ranges, the Rocky Mountain chain is the only portion of the western United States that consistently yields more than 3 cm of flow annually. Ten to 15% of the land mass in the region produces the majority of the total flow. These source areas are primarily the high-elevation alpine and subalpine forest zones. Because of the dominant effect of the snowpack on the annual hydrograph, management opportunities in the snow zone are an integration of responses from snowpack manipulation as well as evapotranspiration modification. Water yield can be increased significantly through forest man-

agement while minimizing the detrimental effects in terms of peak discharges, erosion and sediment production, and channel integrity. Through prudent management, a 2 to 6 cm increase in flow from each ha of land managed to optimize water yield in the subalpine can be realized. The optimal harvest design appears to consist of small openings, irregularly shaped, and about 3 to 8 tree heights in width parallel to the wind. The amount available for such management is only a small portion of the total. Once under management, given a 100- or 120-year rotation, a maximum increase could be maintained from 1/4 to 1/3 of the managed land at any one time because of the effect of recovery. Augmenting water yield through forest management is a viable alternative in the Rocky Mountain region. (Moore-IVI)
W84-01921

WATER YIELD IMPROVEMENT POTENTIAL BY VEGETATION MANAGEMENT ON WESTERN RANGELANDS,
A. R. Hibbert.
Water Resources Bulletin, Vol. 19, No. 3, p 375-381, June, 1983. 3 Fig, 1 Tab, 42 Ref.

Descriptors: *Range management, *Water yield improvement, *Vegetation management, Brush control, Snow management, Chaparral, Shrubs, Aspen, Pinyon, Juniper, Grassland.

Increasing water for onsite and offsite uses can be a viable objective for management of certain western rangelands. An attractive alternative to water harvesting is to replace vegetation that uses much water with plants that use less so that more water percolates through the soil to streams and ground water. Most sites are too dry to increase water yield in this way; probably less than 1% of the western rangelands can be managed for this purpose. However, where annual precipitation exceeds about 450 mm (18 inches) and deep-rooted shrubs can be replaced by shallow-rooted grasses, there is potential to increase streamflows and to improve forage for livestock. The response to treatment appears to be largest in chaparral and somewhat less in other dense brushlands and in aspen. Small increases are possible by thinning ponderosa pine. Little or no increase can be expected by eradication of low-density brush and pinyon-juniper woodlands. On semidesert shrublands and grasslands, the only opportunity to increase streamflow is to increase the overland flow component. Some potential exists to increase water yield on high-elevation grasslands and sagebrush lands by management of blowing snow. With periodic maintenance to prevent shrub regrowth, the long-term water yield increase from chaparral conversion is expected to average 60 mm per year over areas actually converted. The expected increase for mountain brush is about 50 mm per year if conversion is maintained. Even larger increases are possible by removing aspen trees. (Moore-IVI)
W84-01922

POTENTIAL FOR AUGMENTING WATER YIELD THROUGH FOREST PRACTICES IN WESTERN WASHINGTON AND WESTERN OREGON,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
R. D. Harr.
Water Resources Bulletin, Vol. 19, No. 3, p 383-393, June, 1983. 6 Fig, 6 Tab, 15 Ref.

Descriptors: *Water yield improvement, *Forest management, *Washington, *Oregon, Seasonal distribution, Logging, Water demand, Fog interception, Phreatophytes.

Western Washington and western Oregon comprise a water-rich region that has a very uneven annual distribution of both precipitation and streamflow. Highest demand for water coincides with lowest streamflow levels between July 1 and September 30 when less than 5% of annual water yield occurs. Increases in annual water yield in small, experimental watersheds in the region have ranged up to 600 mm after entire watersheds were logged and up to 300 mm in watersheds that were 25 to 30% logged. Most of the increase has occurred during the fall-winter rainy season, and yield increases have been largest during the wettest years. Estimated sustained increases in water yield from most large watersheds subject to sustained yield forest management are at best only 3-6% of unaugmented flows. Realistically, watersheds in this region will not be managed to produce more water. Water yield augmentation will continue to be only a small and variable by-product of logging. The utility of water yield augmentation is limited by its size and by its occurrence relative to the time of water demand. In some local areas, reduction of fog interception and drip or establishment of riparian phreatophytic hardwoods may reduce summer flows. (Author's abstract)
W84-01923

POTENTIAL FOR INCREASING STREAMFLOW FROM SIERRA NEVADA WATERSHEDS,
Pacific Southwest Forest and Range Experiment Station, Soda Springs, CA. Central Sierra Snow Lab.
R. C. Kattelmann, N. H. Berg, and J. Rector.
Water Resources Bulletin, Vol. 19, No. 3, p 395-402, June, 1983. 3 Fig, 3 Tab, 42 Ref.

Descriptors: *Water yield improvement, *Watershed management, *Forest management, *Sierra Nevada, California, Vegetation management, Snowpack, Evapotranspiration, Snow interception, Streamflow delay.

The Sierra Nevada produces over 50% of California's water. Improvement of water yields from the Sierra Nevada through watershed management has long been suggested as a means of augmenting the state's water supply. Vegetation and snowpack management can increase runoff from small watersheds by reducing losses due to evapotranspiration, snow interception by canopy, and snow evaporation. Small clearcuts or group selection cuts creating openings less than half a hectare, with the narrow dimension from south to north, appear to be ideal for both increasing and delaying water delivery in the red fir-lodgepole pine and mixed-conifer types of the Sierra west slope. Such openings can have up to 40% more snow-water equivalent than does uncut forest. However, the water yield increase drops to 1/2-2% of current yield for an entire management unit, due to the small number of openings that can be cut at one time, physical and management constraints, and multiple use/sustained yield guidelines. As a rough forecast, water production from National Forest land in the Sierra Nevada can probably be increased by about 1% (0.6 cm) under intensive forest watershed management. Given the state of reservoir storage and water use in California, delaying streamflow is perhaps the greatest contribution watershed management can make to meeting future water demands. (Author's abstract)
W84-01924

WATERSHED MANAGEMENT FOR JOINT PRODUCTION OF WATER AND TIMBER: A PROVISIONAL ASSESSMENT,
Resources for the Future, Inc., Washington, DC.
J. V. Krutilla, M. D. Bowes, and P. Sherman.
Water Resources Bulletin, Vol. 19, No. 3, p 403-414, June, 1983. 4 Tab, 26 Ref.

Descriptors: *Forest management, *Watershed management, *Water yield improvement, *Cost analysis, Subalpine Zones, Snow interception, Evapotranspiration, Vegetation management, Wildlife, Logging, Hydroelectric power, Habitats.

Removal of forest canopy to reduce interception, evaporation, and transpiration, and to collect blowing snow, etc., increases water yield from small subalpine watersheds. The value of a program to increase streamflows is dependent upon the use made of such water and on the direct value from the vegetation manipulation. Possible benefits of water augmentation include: timber and fuel wood; habitat for desired wildlife species; hydroelectric generation; and the value of water for agriculture, municipal and industrial users. Associated costs include: the cost of access and vegetation removal; value of replaced habitat for displaced wildlife species; cost of facilities to utili
falling water; cost of water conveyance and dist
bution system; and the cost of conveyance f
delivery. The value of a watershed manageme
program was estimated using water yield data fro
Fool Creek, a 714-acre watershed in the Fra
drainage. It is assumed that a watershed is treat
by harvesting 39% in appropriately shaped patch
and that these areas are then harvested repeated
at regular intervals. The value of water in t
region is so great relative to timber that the redu
tion in water yield over time while waiting for t
timber to mature to merchantable size incurs
opportunity cost which is not compensated by t
value of the timber harvested. (Moore-IVI)
W84-01925

**WATER YIELD AUGMENTATION THROUG
FOREST AND RANGE MANAGEMENT
ISSUES FOR THE FUTURE,**
Forest Service, Fort Collins, CO. Watershed Sy
tems Development Group.
S. L. Ponce, and J. R. Meiman.
Water Resources Bulletin, Vol. 19, No. 3, p 41
419, June, 1983. 1 Tab, 16 Ref.

Descriptors: *Water yield improvement, *For
management, *Range management, Watersh
management, Water demand, Water supply, H
droelectric power, Vegetation management.

The demand for more water is increasing throug
out the country. Research on upland watershe
clearly demonstrates that water yield can be i
creased using forest and range management pra
tices. The immediate potential for water yield au
mentation is on carefully selected watersheds th
have the bio-physical potential to produce hi
value water under environmentally acceptab
multiple use management. The first such wat
sheds to be managed in all regions are those th
supply municipal-industrial water directly or co
tribute directly and significantly to hydropow
generation. Management of these types of wat
sheds on any large scale will require changes
approaches to economic analysis and in wat
laws. The opportunity to augment water yield a
large scale program may not be as great as h
been demonstrated on small experimental wat
sheds because of many physical and administrati
constraints. There is little incentive for priva
landowners to manage for the production of
commodity they cannot market. The extent
water yield augmentation using vegetation ma
agement will depend on the need for addition
water as well as the alternative means available
meet this need. (Moore-IVI)
W84-01926

**EVALUATION OF OPERATIONAL CLOU
SEEDING PROJECTS,**
Illinois State Water Survey Div., Champaign.
C.-F. Hsu, and S. A. Changnon, Jr.
Water Resources Bulletin, Vol. 19, No. 4, p 56
569, August, 1983. 3 Fig, 1 Tab, 19 Ref. NS
grants ATM 79-05007, ATM 81-07027.

Descriptors: *Cloud seeding, *Evaluation, Weat
er modification, Statistical methods, Hail, Sno
Rain.

Operational cloud seeding projects, those design
to produce a desired change in the weather a
that are nonexperimental in nature, continue to
pursued widely in the United States. Evaluation
such projects is now recognized as having scient
ic benefits, and a four-year study has address
various techniques and statistical methods to pe
form evaluations and to learn more about how
modify the weather. Most such evaluations hin
on some type of space-time comparisons, but va
comparisons can be obtained only by avoidi
biases in the project design and operation. Facto
relevant to an evaluation include choice of r
sponse variables, sampling unit, project type (ra
snow, or hail), period used for data formatio
target control design, sample size (seeded and u
seeded), covariates, sizes of target and contr
areas, assumed seeding effect (additive, multiplic
tive, or varying), and statistical techniques en

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. Rerandomization testing is recommended
actual evaluation of operational cloud seed-
ojects. Valid comparisons can be obtained
one avoids certain obvious biases. Elements
l to better evaluations are: using uniformly
l observations for seeded and nonseeded oc-
; using a uniform method in measuring re-
variables; selecting target control design
tistical technique a priori; adhering rigor-
o a preordained protocol; and documenting
ding operation as completely as possible,
ng seeding criteria used, methods of collect-
l recording data, seeding agent amount and
instrumentation, and seeding rate. It ap-
hat useful evaluation of operational projects
made. (Moore-IVI)
940

Use Of Water Of Impaired ity

EWATER REUSE: A RESOURCE OR A NCE,
an Water Works Association Research
tion, Denver, CO.
mary bibliographic entry see Field 5F.
799

RFLOODING WILL BENEFIT SOME ESERVOIRS,
os Mexicanos, Mexico City.
s-Gomez.
Oil, Vol. 196, No. 5, p 71-82, April, 1983. 6
Tab, 6 Ref.

tors: *Gas wells, *Water injection, Water-
g, Gas reservoirs, Aquifers, Injection wells.

nod is proposed for increasing recovery
as condensate reservoirs with retrograde
sation and high structural relief, by means
taining reservoir pressure above dew point
water injection. The technique is to inject
the vicinity of the water-gas contact, or in
ent points in the bottom of the gas-bearing
maintain reservoir pressure at such a level
tomhole flowing pressure of the producing
emains above the dew point of the fluids.
thod is highly recommended where appli-
nce, according to a case study, expected
y increases range from 111% to 210% for
and from 3.55% to 6.5% for gas. The
avoids retrograde condensation during the
njection stage and the consequent loss of a
olume of liquids. It also maintains a high
r pressure, reducing compression require-
During the pressure maintenance stage,
oductivities are sustained by preventing
ccumulation in the wellbore vicinity. The
r should not have an active aquifer.
-IVI)
050

Conservation In Domestic and cipal Use

ER'S WATER CONSERVATION PRO-
Water Dept., CO.
Viley.
of the American Water Works Associa-
l. 75, No. 7, p 320-323, July, 1983. 1 Tab, 5

tors: *Water conservation, *Water use,
r, Education, Information, Water reuse,
Irrigation, Municipal water, Evapotran-
n, Plumbing, Pricing.

nse to water shortages and a court decree,
ver Water Department has undertaken a
of programs to restrict water use during
wing season and to develop a conservation
nong customers without imposing unrea-
lifestyle changes. The Denver potable
euse demonstration project, scheduled for
ion in 1983, is designed to determine
potable water that is comparable in qual-
ity to Denver's existing supply can be continuously and reliably produced from secondary sewage effluent. Other water saving programs are the department's restrictions on water use in the summer months and tap allocations. The conservation program embodies a number of well-known methods of reducing water usage, including: retrofitting plumbing fixtures, plumbing code revisions, leak detection, universal metering, and conservation through rate modification. One of the most easily implemented and least controversial programs is the education and public information program. Approximately 80% of all residential water use in the Denver system goes into yard irrigation, mainly bluegrass lawns, during the summer months. The ET (evapotranspiration) program is aimed at reducing the use of water for lawn watering through the use of ET data by homeowners. (Moore-IVI)
W84-01794

CHOOSING THE OPTIMAL WATER CONSERVATION POLICY,
Policy Sciences Associates, Boulder, CO.
W. B. Lord, J. A. Chase, and L. A. Winterfield.
Journal of the American Water Works Association, Vol. 75, No. 7, p 324-329, July, 1983. 6 Tab, 6 Ref.

Descriptors: *Water conservation, *Policy making, Administrative decisions, Public policy, Colorado, Surveys, Public opinion, Colorado.

A random sample survey was made of 600 residential water users who live in three medium-sized communities along the Front Range of Colorado to study public acceptance, effectiveness and financial feasibility of various outdoor water use conservation programs. The study was specifically concerned with conservation of water used for lawn watering, because this type of use accounts for nearly half of the total residential water use in these communities. Policies that provided information about water conservation actions and their consequences or ones that provided information about the need for practicing conservation were the most acceptable to the consumers. Policies that would be more effective in achieving conservation than sole reliance on information were less widely accepted. Still, policies that rewarded consumers who took actions to conserve water and policies that included restrictions on water use that appeared to be both equitable and not too confining were acceptable to most users. Policies that penalized those who did not conserve or policies that included restrictions perceived to be inequitable, severe, or both were unacceptable to most. Conservation pricing was moderately acceptable and would be one of the more effective policies in achieving water use reductions. A substantial majority of users preferred increasing or inverted block pricing to the more common declining block pricing policy. The best combination of water conservation policies for a municipal water utility depends on the relative weights that decision makers place on the three criteria of acceptability, effectiveness, and financial feasibility. Public information is a logical component for any municipal water conservation program. Beyond that, conservation pricing deserves prime consideration for a utility emphasizing either effectiveness or financial feasibility. A utility emphasizing acceptability faces a difficult choice, because there tends to be an inverse relationship between acceptability and effectiveness. (Baker-IVI)
W84-01795

REDUCING WATER DEMAND AND WASTEWATER FLOW,
Brown and Caldwell, Walnut Creek, CA.
W. O. Maddaus, D. S. Parker, and A. J. Hunt.
Journal of the American Water Works Association, Vol. 75, No. 7, p 330-335, July, 1983. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Water conservation, *Wastewater management, *Domestic water, Water use, Toilets, Showerheads, Faucets, Infiltration, Nonstructural alternatives, California, Dublin, San Ramon, Pleasanton.

The Dublin, San Ramon, and Pleasanton areas of California are located in an inland valley. Wastewater must be exported from the valley and discharged to San Francisco Bay. Water conservation, resulting in reduced volumes of wastewater flow, is considered far more cost-effective than increasing disposal capacity. Inside residential water use of wastewater flow could be reduced by about 10% if low-flush toilets, low-flow showerheads, and low-flow lavatory faucets were installed throughout the area. Such fixtures are now required for new construction in California. Retrofitting existing homes could be accomplished with an aggressive program to make older homes more water efficient. Infiltration from overwatering of lawns, leaking plumbing, or both accounts for 15 to 30% of measured wastewater flow from homes. (Moore-IVI)
W84-01796

NONCRISIS USE OF HOUSEHOLD WATER-SAVING DEVICES,
Wisconsin Univ.-Stevens Point. Dept. of Economics and Business.
D. J. Palmini, and T. B. Shelton.
Journal of the American Water Works Association, Vol. 75, No. 7, p 336-341, July, 1983. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Water conservation, *Public opinion, Administrative decisions, Public policy, Water supply, New Jersey, East Brunswick.

In anticipation of a severe water supply shortfall that could occur within the next 20 years, a limited domestic water conservation program was undertaken in East Brunswick, N.J. The implementation of the first phase of the water master plan is described and analyzed. One important finding is the evidence that the public will cooperate with a water conservation program, even in the absence of strong external incentives such as a drought. Two thirds of the householders in the first phase of the study voluntarily installed at least one of the devices when told of the benefits to the township and of the private monetary benefits to them, along with receiving two letters from municipal officials urging their cooperation. Statistical measures of the resulting water savings were developed from field studies. It was estimated that a program of this nature would save East Brunswick an average of 18964 L of water per home each year. This figure is comparable to the savings measured in two studies in California in 1977. Water may be produced by investing in new wells, reservoirs, pipelines, and pumping and treatment plants, but utilities can also produce new water through water saving techniques. While this is not the ultimate answer to the nation's growing water supply problems, it is nevertheless both effective and cost effective. It is a strategy that should be more seriously and more widely used in the long run management of water resources. (Baker-IVI)
W84-01797

MINIMUM-FLOW PLUMBING FIXTURES,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
R. L. Siegrist.
Journal of the American Water Works Association, Vol. 75, No. 7, p 342-347, July, 1983. 1 Fig, 3 Tab, 38 Ref.

Descriptors: *Water conservation, *Plumbing fixtures, Domestic water, Minimum-flow fixtures, Cost effectiveness.

Minimum-flow plumbing fixtures and household appliances, designed to reduce water consumption by 50 to 90%, provide comparable service, are functionally similar to conventional products, are compatible with utility systems, and are potentially cost-effective. Further development and use of the products are warranted, particularly for domestic uses. Dramatic reductions in water demand resulting from the use of minimum-flow fixtures can have a significant effect on water, wastewater, and energy services. Despite the successful use of minimum-flow plumbing fixtures, there are factors that hinder their development and widespread application. These barriers are a mixture of technical,

social, economic, and institutional factors. (Moore-IVI)
W84-01798

WATER USAGE AND THE QUANTIFICATION OF UNACCOUNTED WATER IN A UNIVERSALLY METER SUPPLY AREA,
J. H. Philips.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 4, p 325-335, August, 1983. 2 Fig, 7 Tab, 6 Ref.

Descriptors: *Leakage, *Water loss, Monitoring, Water usage, Metering, Water distribution.

The only reliable means of ascertaining leakage in a distribution system is to take the summation of the individual minimum hours consumption on a number of waste metered zones and to express this as a minimum consumption for the total area considered; or to set up a section of the distribution network fed by one service reservoir and to measure the drop on that reservoir over a period of time and select the minimum hours consumption, preferably on a holiday or non-working night, and to deduct from this any unknown metered consumption during the minimum hours. If this is done it is possible to take the remaining quantity as the leakage on the system, which should not exceed 2.25 l/house/hr. This is some 12% of the average consumption. Elimination of a quantity lower than this is likely to be uneconomic. The effect of variation of industrial and trade metering policies and municipal and water service uses on the unaccounted for percentage of the water produced at source works is also demonstrated. The need for reliable statistics obtained from accurate field data is a continuing requirement for management of a water undertaking. (Baker-IVI)
W84-01821

3E. Conservation In Industry

WATER RE-USE IN PROCESSING OF PACIFIC SHRIMP,
Castle and Cooke, Inc., San Jose, CA.
L. A. Nielsen, R. J. Price, and P. A. Carroad.
Journal of Food Science, Vol. 48, No. 4, p 1056-1060, July-August, 1983. 10 Fig, 2 Tab, 6 Ref.
NOAA grant NA80AA-D-00120.

Descriptors: *Water conservation, *Water reuse, *Food processing industry, Shrimp, Fluming, Counter current flow, Cost analysis.

A Pacific shrimp (Pandalus jordani) processing plant was instrumented to measure water usage. Water consumption in the conventional processing amounts to 25-40 gallons of potable water to produce 1 lb. of finished shrimp. A water balance was completed which identified fluming as a main user of water and subject to design improvements. Re-use of water in fluming was investigated in pilot plant simulation to evaluate alternatives to fresh flow usage. A counter current flow system was designed to reduce water usage from 264 gpm to 156 gpm with acceptable microbiological quality. An economic analysis of the impact of counter current water re-use was accomplished using the actual plant operating rate of 430 lb. of shrimp per peeler. Calculations were based on processing one million pounds in a six month season. The total annual savings as a result of the recycle modification would be between $1,400 and $4,500, depending on the municipal and sewer rates. (Moore-IVI)
W84-02048

MAKE-UP WATER TREATMENT AT THERMAL POWER PLANTS AND MULTIPLE WASTE WATER RE-USE,
For primary bibliographic entry see Field 5D.
W84-02112

3F. Conservation In Agriculture

EFFECT OF SYNTHETIC CONDITIONERS ON SOIL WATER RETENTION, HYDRAULIC CONDUCTIVITY, POROSITY AND AGGREGATION,
American Univ., Beirut (Lebanon). Dept. of Soils, Irrigation and Mechanization.
M. N. Nimah, J. Ryan, and M. A. Chaudhry.
Soil Science Society of America Journal, Vol. 47, No. 4, p 742-745, July-August, 1983. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Soil conditioners, *Soil water, *Sand, *Clays, Soil texture, Arid lands, Permeability coefficient, Soil porosity, Lebanon.

Soils of extremes in texture - either sands or clay, present problems in the use of synthetic soil conditioners in the modification of soil water relationships especially in arid regions. Hygromull (a urea formaldehyde) and Agrosil LR and Agrosil S (amorphous sodium hydrosilicates) were evaluated in the laboratory on soils of different textures. Soil samples were selected from three locations in Lebanon: Leba'a in the south; Furzol in the central Beka'a valley; and Sheia'h near Beirut on the coast. Available water content was increased by Hygromull and Agrosil LR. Saturated hydraulic conductivity of the clay soils was improved by Hygromull, while that of the sandy soil was reduced by Agrosil LR. Hygromull increased porosity of all soils but, unlike Agrosil LR, had no effect on aggregation. Agrosil S had no effect on any property studied. Hygromull has greatest potential for commercial use since it was comparatively effective with both sandy and clay soils. While Agrosil LR is likely to be of some benefit in sandy soils, the acidic S form of this material is ineffective and warrants no further testing. (Moore-IVI)
W84-01865

SOIL WATER CHANGE AS RELATED TO POSITION OF WHEAT STRAW MULCH ON THE SOIL SURFACE,
Agricultural Research Service, Akron, CO. Central Great Plains Research Station.
D. E. Smika.
Soil Science Society of America Journal, Vol. 47, No. 5, p 988-991, September-October, 1983. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Fallow, *Mulches, *Straw, *Soil water, Evaporation, Water loss, Wind, Great Plains.

A field study was conducted in the Central Great Plains to determine the effects of the position of wheat straw mulch on soil water change of a silt loam soil (a montmorillonitic, mesic Aridic Paleustoll) during three 14-month fallow periods. Treatments of 4600 kg/ha of wheat straw mulch flat on the soil surface, 3/4 flat and 1/4 standing, or 1/2 flat and 1/2 standing (normal position following standard combine harvesting) were compared with bare soil. Standing stubble was 0.46 m tall. Soil water content of one 1 cu m hydraulic lysimeter within each treatment was measured daily and changes summed for each week, and at a distance of 2 m from each side of the lysimeter a neutron depth probe was used to determine soil water content weekly except when the soil was frozen. The relationship of soil water change for each weekly period with weekly values of total precipitation, total open-pan (U.S. Weather Bureau Class A) evaporation, average daylight-hour vapor pressure deficit, average maximum air temperature, average daily air temperature, average daylight-hour air temperature, total solar radiation, and average daily wind movement, was determined by single and multiple-correlation techniques. Soil water increases were related only to precipitation events with the highest correlation resulting from the 1/2 flat 1/2 standing wheat straw position treatment. Soil water losses were best correlated with wind movement with r(2) values of 0.55, 0.41, 0.41, and 0.32 for bare soil, flat 3/4 flat-1/4 standing, and 1/2 flat-1/2 standing treatments, respectively. Soil water loss occurred from both bare soil and where the mulch was flat with winds of 0.08 M/S. When 1/4 or 1/2 of the mulch was standing, a wind of at least 0.55 M/S was needed before soil water loss occurred. Standing wheat straw does not function as a wick for loss of water from the soil. (Author's abstract)
W84-01873

EFFECT OF EXCHANGEABLE SODIUM AN GYPSUM ON SURFACE RUNOFF FRO LOESS SOIL,
Agricultural Research Organization, Bet-Dag (Israel). Inst. of Soils and Water.
R. Keren, I. Shainberg, H. Frenkel, and Y. Kalo.
Soil Science Society of America Journal, Vol. 4 No. 5, p 1001-1004, September-October, 1983. Tab, 17 Ref.

Descriptors: *Surface runoff, *Exchangeab sodium, *Gypsum, Soil conditioners, Soil infiltr tion, Soil surface, Soil crust, Loess.

Surface runoff from a deep silt loam loess soil two exchangeable sodium percentage (ESP) valu (4.6 and 19.3), and the beneficial effect of industri gypsum, were studied in field plots (of 150 sq each) under natural rainfall conditions. The ESP the soil was found to have a very pronounce effect on the surface runoff in spite of the fact th the final infiltration rate of the soil was affecte only slightly by the ESP of the soil. The effect ESP on the percent of surface runoff is probabl through its effect on the rate of crust formatio The percent of surface runoff increase during th rainy season, for both ESP levels, because th runoff from already crusted soil was higher. Hov ever, the effect of consecutive storms depended o the degree of drying between storms. Applicatio of industrial gypsum was found to be very effe tive in lowering surface runoff from the so Spreading the gypsum over the soil was mo effective than mixing it in the upper 10 cm of so by disk. Localization of the gypsum at the so surface, where crust is formed, explains this effec Gypsum application lowered the ESP of the upp 10-cm layer for both gypsum treatments. Since th ESP of the soil in both gypsum treatments wa about the same, it seems that the most importa factor which controlled infiltration was the ele trolyte concentration in the percolating solutio (Author's abstract)
W84-01876

MATHEMATICAL MODEL FOR BORDE STRIP IRRIGATION,
G. J. Weir.
Water Resources Research, Vol. 19, No. 4, p 101 1018, August, 1983. 5 Fig, 23 Ref.

Descriptors: *Model studies, *Irrigation, Borde irrigation, Infiltration, Gravity, Water resource development, Kinematic models.

A kinematic model is developed to discuss surfac irrigation when the infiltration function consists o a long-time gravity term plus a short-time capillar or sorbitivity term. The corresponding mode equations are solved either exactly or numerically and several graphical solutions are presented Using the kinematic solution a condition is suggest ed for the validity of the corresponding Lewis Milne problem, and from the shallow water o dynamic equations are suggested a condition fo the validity of the kinematic solution. The centra mathematical approximation in the model is th discontinuous infiltration function which assume a linear gravity term plus a discontinuous capillar or capture term. (Baker-IVI)
W84-01894

PULSED TRICKLING EFFECTS ON SOI MOISTURE DISTRIBUTION,
Illinois Univ. at Urbana-Champaign.
S. Mostaghimi, and J. K. Mitchell.
Water Resources Bulletin, Vol. 19, No. 4, p 605 612, August, 1983. 5 Fig, 2 Tab, 5 Ref.

Descriptors: *Trickle irrigation, *Soil water, Simu lation, Mathematical models, Pulsed application Continuous application, Runoff, Trickle emitters Water loss, Water conservation.

Laboratory experiments were conducted to study effects of trickle emitter discharge rate on the distribution of soil moisture in a silty-clay loam soil. Both pulsed and continuous irrigation treat ments were studied. A simulation model was used to evaluate the results obtained in the laboratory

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greement between the predicted and meas-
oil moisture distribution patterns was quite
For both pulsed and continuous applications,
ing trickle discharge rate resulted in a de-
in the horizontal component and an increase
vertical component of the wetted soil pro-
Compared to the continuous treatments,
applications resulted in significant reduction
er loss below the root zone. Pulsed applica-
ates can replace continuous small discharge
reduce irrigation water runoff problems on
soils and with restricted infiltration allow
of larger emitter orifices to decrease poten-
gging of the trickle system. (Author's ab-

1946

ATER QUANTITY ANAGEMENT AND ONTROL

Control Of Water On The rface

FILLING OF KIELDER RESERVOIR FUTURE OPERATIONAL CONSIDER-IS,
rady, J. M. Davis, and E. W. Douglas.
of the Institution of Water Engineers and sts, Vol. 37, No. 4, p 295-312, August, 1983. Tab, 14 Ref.

ptors: *Reservoirs, Water resources devel-, Thermal stratification, Suspended solids, mnion, Deoxygenation, Kielder Reservoir, langanese.

peration of Kielder reservoir is reviewed the first two years of filling 1981 and 1982. impounding and abstraction licences and ed water supply abstraction licences on the North Tyne and Tyne are described and ed. High concentrations of suspended soilds resent in discharges to the river North Tyne the first five months of filling. The reservoir ly stratified during the summer of 1981 and olimnion became deoxygenated. Although e lowest level reservoir draw-off was avail-rough this period, the quality of water dis- to the river North Tyne was satisfactory. alled aeration system was effective in con- the extent of deoxygenation and restricting nation of high iron and manganese concen-. A discussion of future discharge regimes ro-electric power generation, and measures ay be taken to protect and maintain the Tyne migratory fishers are presented. IVI)
819

LEMS OF SMALL WATER SUPPLIES,
arden.
of the Institution of Water Engineers and ts, Vol. 37, No. 4, p 313-324, August, 1983. Tab, 2 Ref.

ptors: *Water supply, *Quality control, areas, Water treatment, Disinfection, g water, Rural areas, Great Britain.

s concern all over the world in industrial-untries as well as in developing countries to e the standards of rural water supplies. A udy was made of about 300 small public in Great Britain to obtain some way of factors into perspective. Of the supplies ed the source in 9 cases was boreholes, 67 of reservoirs, 69 used streams, 38 springs 10 the source of water was undefined. Of supplies, 29 had coagulation with filtration netimes settlement, flows being as small as bic meters/day. In general these were or at least visited daily. A total of 56 ad slow sand filters, mostly of the Scottish type. Some 29 supplies had pH adjust-There were no cases of the use of ozone or e dioxide and only a few places used ultra-radiation for disinfection. Of all sites, 42% had no disinfection at all and the remainder used chlorination. Chlorine gas was used on 23% of the supplies, disinfection with hypochlorite solution was reported for 30%, and calcium hypochlorite tablets were used on 4%. A few of the largest works in the survey were manned on the day shift, but visits were the norm for small supplies. About 31% reported daily visiting, 27% visited two or three times per week and 42% visited weekly. Quality surveillance is the responsibility of scientific services and the frequency of quality sampling varies from weekly to every six months. However, even with the sometimes primitive simplicity with which these supplies are maintained, cases of water-borne diseases are very rare. (Baker-IVI)
W84-01820

CURRENT ISSUES AND FUTURE NEEDS IN URBAN STORM DRAINAGE,
Hydraulics Research Station, Wallingford (England).
P. J. Colyer, and B. C. Yen.
Water Research, Vol. 17, No. 9, p 1067-1071, Sept, 1983.

Descriptors: *Storm drainage, Drainage, Runoff, Rainfall-runoff relationships, Model studies, Urban drainage, Storms.

Discussions and observations made during a conference on urban storm drainage are summarized. Various phenomena have recently occurred which have produced a renewed interest on the international level in urban storm drainage. Several nationally co-ordinated research and application programs have been developed. Knowledge is needed in areas such as the temporal and spatial variations of storm rainfalls, practical and reliable routing techniques for unsteady sewer flow, and the nature of overland flow. The process of storm rainfall, surface flow, pollution entrainment and transport and unsteady flow in sewers lends itself in a particularly satisfying way to mathematical simulation. However, there are trends in both the direction toward sophisticated modelling and towards simplification. Drainage management, with its need for detailed knowledge of the hydraulic performance of existing systems under specified rainfall conditions, will probably demand computer modeling of surcharged networks. However, the computer will not meet all the needs of drainage engineers. The proper collection of data is of extreme importance along with determining what to measure and how to generalize observed results in storm water quality studies. (Baker-IVI)
W84-01909

IMPACT OF DROUGHTS AND FLOODS ON THE ENVIRONMENT,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. Khublarian.
Ambio, Vol. 12, No. 2, p 78-79, 1983. 3 Fig.

Descriptors: *Droughts, *Floods, Flood control, Environmental effects, Runoff, Irrigation.

The future may be freed from the environmental, social, and economic devastation brought on by floods and droughts. Advances in research can create means and methods for actively influencing the atmospheric processes that cause these natural disasters. Although the problem of floods and droughts can be radically solved by means of runoff regulation, creating the irrigation systems and application of various irrigation methods requires massive infusions of funds. The development of reliable technological and socio-economic means of prediction and control might eliminate the need for drastic, costly measures now in use. These pro-ecological means will stress optimization of physio-geographic characteristics, river basin protection, and careful treatment of the environment. The long term goals can only be achieved through cooperative efforts and an international sharing of scientific and technological knowledge. (Baker-IVI)
W84-01968

RIVER BASIN MANAGEMENT,
Economic and Social Commission for Asia and the Pacific (UN), Bangkok (Thailand).
V. R. Pantulu.
Ambio, Vol. 12, No. 2, p 109-111, 1983. 3 Fig, 3 Ref.

Descriptors: *River basins, *Water management, International agreements, River management.

Very little information exists that could provide a basis for the formulation of universally applicable principles or arrangements for international river basin management or for sharing of waters. International river basin management ranges from marginal or no cooperation among the co-sharers to a fairly high degree of harmonious cooperation. In cases where no cooperation exists between co-sharers the principal reasons appear to be disparity in economic and technological development between cosharers; mistrust of the political intentions and objectives of neighbors; and lack of genuine international interest in encouraging regional development in the basin due to the political stance of one or more of the co-riparians. Efforts are needed to evolve relatively simple and inexpensive assessment techniques and procedures for gathering basic data; conducting studies on the effects of various types of land uses on water yield, retention and quality, under different typical situations, with the object of deriving information that could be used for planning purposes; training technicians from low-latitude countries in river basin management and regional planning; and conducting comprehensive case studies on river basin management and equitable sharing of resources in ecologically representative major river basins in different parts of the world. (Baker-IVI)
W84-01970

SUB-OPTIMAL CONSTANT-VOLUME CONTROL FOR OPEN CHANNEL NETWORKS,
Cagliari Univ. (Italy). Inst. of Electrotechnics.
G. Corriga, S. Sanna, and G. Usai.
Applied Mathematical Modelling, Vol. 7, No. 4, p 262-267, August, 1983. 10 Fig, 3 Ref.

Descriptors: *Automation, *Open channels, *Networks, Mathematical models, Gates, Canals, Simulation.

A state variable mathematical model for use in the synthesis of automatic control systems for open-channel networks is presented. The system considered here consists of n-cascaded reaches joined by control gates. The linear time invariant model consists of a controllable and observable representation where the state variables are the stored water volume variations in each reach and the control signals are the variations of the control gates opening sections. The model derives, through appropriate simplifications, from a more complex one in terms of transfer functions which was derived by linearizing the Saint-Venant equations. The problem of a linear quadratic optimal regulator is formulated in classical terms for the canal system and the constant-volume control laws obtained for the simplified model have been imposed on the complex one: such a control is therefore to be considered sub-optimal. The results of a digital simulation of the controlled system behavior indicate that the system operates with practically constant stored water volumes in each reach and that such behavior is fairly close to that of a pressure-water pipe system. (Author's abstract)
W84-01996

4B. Groundwater Management

GROUNDWATER LAWS: OPPORTUNITIES FOR MANAGEMENT AND PROTECTION,
Calhoun, Hubbard, Riddle and Cox, Savannah, GA.
W. W. Ballew, III.
Journal of the American Water Works Association, Vol. 75, No. 6, p 280-287, June, 1983. 3 Fig, 24 Ref.

Descriptors: *Water law, *Groundwater management, *Georgia, Federal jurisdiction, State jurisdiction, Legal aspects, Groundwater pollution,

Waste disposal, Water pollution control, Groundwater depletion, Permits, Hazardous materials.

Present and future protection of the nation's groundwaters depends on controlling the interrelated problems of excessive withdrawals and contamination. The existing legal authority and gaps in federal and state regulatory laws as they apply to use of aquifers underlying the state of Georgia were identified. The findings of this prototype case study could be applied in many states to coordinate and enhance groundwater protection, thus assuring the availability and safety of this natural resource. The Ground Water Use Act represents Georgia's primary groundwater protection statute. The act requires major users to obtain a permit before making withdrawals, but uses for agriculture are excluded from permit requirements. Through the Hazardous Waste Management Act and the Hazardous Waste Management Authority Act, Georgia has begun an attempt to supervise the disposal of dangerous wastes. Though Georgia has coordinated its statutes well with federal laws, the need to reach agreements with neighboring states remains. (Moore-IVI)
W84-01789

AQUIFER THERMAL ENERGY STORAGE: AN ATTEMPT TO COUNTER FREE THERMAL CONVECTION,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, J. G. Melville, O. Guven, and A. D. Parr.
Water Resources Research, Vol. 19, No. 4, p 922-930, August, 1983. 16 Fig, 3 Tab. 12 Ref. DOE subcontract B-67770-A-0.

Descriptors: *Injection wells, *Thermal energy storage, *Recovery wells, Aquifers, Geohydrology, Transmissivity, Heat conduction, Mobile, Alabama.

In an attempt to counter the detrimental effects of convection on aquifer thermal energy storage (ATES), a dual recovery well system was constructed at a Mobile (Alabama) site and an injection-storage-recovery cycle performed. Using a partially penetrating well, cycle 3-3 injection began on April 7, 1982. A total of 56,680 cu m of 79 C water was injected. After 57 days of storage, production began with a dual recovery well system. Due to the dominating effect of nonhomogeneities, the dual well system did not work particularly well, and a recovery factor of 0.42 was achieved. The degree of aquifer heterogeneity at the location of the present experiments was not apparent during previous experiments at a location only 109 m away, although pumping tests indicated similar values of transmissivity. Therefore aquifers with the same transmissivity can behave quite differently in a thermal sense. Heat conduction to the upper aquitard was a major energy loss mechanism. Water sample analyses indicated that there were no important changes in the chemical constituents during the set of experiments. There was a 19% increase in total dissolved solids. At the end of injection, the land surface near the injection well had risen 1.39 cm with respect to bench marks located 70 m away. The average elevation gradient was 0.0002. Depending on local stratigraphy, injection temperature, and injection volume, elevation changes 2 or 3 times greater than those observed at the Mobile site seem possible. (Moore-IVI)
W84-01885

LEAKY ACRES RECHARGE FACILITY: A TEN-YEAR EVALUATION,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
H. I. Nightingale, J. E. Ayars, R. L. McCormick, and D. C. Cehrs.
Water Resources Bulletin, Vol. 19, No. 3, p 429-437, June, 1983. 5 Fig, 5 Tab, 15 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, Costs, Recharge basins, Recharge rate, Turbidity, Alluvial soils, Soil surface, Storm runoff, Soil erosion, Water quality, California, Fresno, Leaky Acres Recharge Facility.

From 1971-1980, studies were conducted at the Leaky Acres Recharge Facility, Fresno, California, to identify and quantify the factors that determine the long term (10-year) effectiveness of basin type artificial ground water recharge through alluvial soils. High quality irrigation water from the Kings River was used for recharge. Construction and land costs for the present expanded facility 83 ha (205.2 ac) using three parcels of land were $1,457,100. The nine-year annual mean costs for only canal water, maintenance, and operation were $110.42/ha.m ($13.62/ac.ft) based on an average recharge rate of 1338 ha.m/yr (10,848 ac.ft/yr) at 86% facility efficiency. The measured end of season recharge rate averaged 14.97 + or - 0.24 cm/day. The 10-year mean actual recharge rate based on actual water delivered, total ponded area, and total days of recharge was 12.1 cm/day. The success of the project is related to: the low turbidity, nutrients, and salt content of the input water; permeable sandy surface soils and favorable subsurface geology that allows rapid horizontal movement of the water; good management to control the major biological factors leading to clogging of the surface soils; and cooperation between the irrigation district that delivers the water, city personnel who manage the facility, and research personnel. The major problems are related to soil erosion within the basins, and the resulting surface sealing with fine soil particles, as governed by the ground surface slopes in the borrow strip for soils used to built the levees. The continued success of this recharge project is highly dependent upon keeping turbid storm runoff water out of the basins. (Moore-IVI)
W84-01928

TEN YEARS TO SLAKE A GLOBAL THIRST,
For primary bibliographic entry see Field 6D.
W84-02011

WATERFLOODING WILL BENEFIT SOME GAS RESERVOIRS,
Petroleos Mexicanos, Mexico City.
For primary bibliographic entry see Field 3C.
W84-02050

4C. Effects On Water Of Man's Non-Water Activities

HYDROLOGY AND SOIL LOSS FROM A HIGH-FERTILITY, ROTATIONAL PASTURE PROGRAM,
Science and Education Administration, Coshocton, OH.
L. B. Owens, R. W. Van Keuren, and W. M. Edwards.
Journal of Environmental Quality, Vol. 12, No. 3, p 341-346, July-September, 1983. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Agricultural runoff, *Grazing, *Cattle, *Soil loss, Vegetation, Environmental effects, Pasture management, Precipitation, Ohio.

Five small watersheds (0.25-3.1 ha) on sloping uplands in eastern Ohio were used to evaluate environmental effects of a beef management program of rotational summer grazing on one area, and rotational winter grazing/feeding with stored hay on another area. During the 5-y study, annual precipitation was 1080 mm, which was 8-15% greater than the long-term average. The surface runoff was measured by precalibrated H-flumes, and automatically sampled using Coshocton wheels. Surface runoff from watersheds with beef cattle management increased, compared with the long-term averages when hay was grown on the watersheds. Greater precipitation was the primary factor causing more runoff during the growing season (May-October), and the cattle management was a major contributing influence on the runoff increase during the dormant season (November-April). Maintenance of good vegetative cover on the study areas was a major factor in limiting annual average surface runoff to < 110 mm, which was a relatively small amount. The large runoff events, although a small percentage of the total number of events, produced most of the runoff volume. Soil loss from these pastures was minima
(Author's abstract)
W84-01807

4D. Watershed Protection

BURIED PIPE SYSTEM FOR CONTROLLIN EROSION AND SEDIMENT LOSS ON IRR GATED LAND,
Agricultural Research Service, Kimberly, ID Snake River Conservation Research Center.
For primary bibliographic entry see Field 5C
W84-01866

SEDIMENT DEPOSITION ESTIMATIO FROM CESIUM-137 MEASUREMENTS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W84-01938

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

LONG-CHAIN ALKYBENZENES AS MOLECU LAR TRACERS OF DOMESTIC WASTES I THE MARINE ENVIRONMENT,
Massachusetts Univ., Boston.
R. P. Eganhouse, D. L. Blumfield, and I. R. Kaplan.
Environmental Science and Technology, Vol. 17 No. 9, p 523-530, September, 1983. 6 Fig, 3 Tab, 4 Ref. DOE contract EY-76-3-03-0034.

Descriptors: *Environmental tracers, *Domesti wastes, *Municipal wastes, Linear alkylbenzenes Surfactants, Marine environment, Marine sedi ments, Particulates, Alkyl benzenes, Los Angeles California.

A suite of secondary C10-14 substituted benzene known as linear alkylbenzenes (LABs) were found in southern California's municipal wastes. These compounds are manufactured for the production o the linear alkylbenzenesulfonate (LAS) surfactant used in commercial detergent formulations. Thus their appearance in wastes is believed to result from incomplete sulfonation of the linear alkylben zenes and subsequent carryover in detergents and/ or by desulfonation of LAS. LABs were evaluated as waste tracers in the marine environment by determining their concentration and composition in suspended particulate matter and sediments in the vicinity of a major wastewater outfall system. They appear to be preserved in sediments for time periods of 10-20 years. A complex assemblage o surfactant-related branched alkylbenzenes was also found in the waste-affected sediments. Sedimentary distributions of both the linear and branched alkyl benzenes are discussed in terms of the historical emission of wastes in Los Angeles and surfactant usage rates. The results demonstrate that LABs are potentially useful as molecular tracers of domestic wastes and, under appropriate conditions, as geochronological tools. (Author's abstract)
W84-01780

CHLORINATED NEUTRAL ORGANICS IN BIOLOGICALLY TREATED BLEACHED KRAFT MILL EFFLUENTS,
Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).
R. H. Voss.
Environmental Science and Technology, Vol. 17, No. 9, p 530-537, 1983. 6 Fig, 4 Tab, 59 Ref.

Descriptors: *Kraft mills, *Bleaching wastes, *Chlorinated hydrocarbons, Effluents, Pulp and paper industry, Organic compounds, Chlorine, Biological wastewater treatment, Chlorinated sulfones, Chloroform, Canada.

ccurrence of chlorinated organic material in iquors from the bleaching of kraft pulp is an ble result of the common practice of using a bleaching agent. Although more than 100 ated organic compounds have been identi- untreated process effluents from the kraft ing process, far fewer chlorinated organics een found in biologically treated combined ed kraft mill effluent. Biologically treated ed mill effluents sampled at nine softwood ed kraft mills located across Canada were ed for chlorinated neutral organic com- . The test results showed only four main ated compounds: chloroform (7-105 micro dichlorodimethyl sulfone (64-429 micro g/ chlorodimethyl sulfone (0.3-12.4 micro g/L), ntatively) tetrachlorodimethyl sulfone (0.4- ro g/L). Unlike chloroform, the chlorinated s were found to be relatively resistant to l by biological treatment in an aerated . However, preliminary assessment of fish mulation potential, acute fish toxicity, and mutagenicity indicated that the chlorinated s would have no immediate adverse effect aquatic environment. (Moore-IVI)
1781

CTS OF TOXIC POLLUTANTS ON INDI- R GERMS IN LARGE-SCALE SOLID- E ECOSYSTEMS,
rg Univ. (Germany, F.R.). Fachbereich Hu- dizin.
Knoll, H. H. Rump, and W. Schneider.
icology and Environmental Safety, Vol. 7, p 463-474, October, 1983. 9 Fig, 1 Tab, 14

ptors: *Bioindicators, *Hazardous materials, vater treatment, Lysimeters, Bacteria, Cyan- henols, Metals, Pesticides.

cale model landfills have various disadvan- uch as wall effects, excessive heat radiation, reproducible leaching effects due to inhomo- es in the waste material. Reisolation tests nade of indicator bacteria with respect to l and horizontal leachate fluxes within the nold, carried out with the aid of large-scale ers. Such investigations should provide an into how pathogenic bacteria behave after ing them into various levels of already ex- vaste and molds. E. coli-d type 0119 from poules introduced into the upper layer of er No. 2 could still be detected after 8 whereas type 0-86 had already died off weeks. Contradictory results were obtained bacteria within the waste in the sample ut of the four bags placed into a layer at a of about 3.5 m at various positions, after 4 bacteria could be reisolated from only one. neter No. 9, for technical reasons, sample uld only be placed into the upper layer. and 8 weeks the sample bags were recov- nd no test bacteria, either from the ampoules n the wastes, could be reisolated. Whether lethal temperatures for microorganisms eached after completion of the construction lysimeters could not be decided from the ed temperatures, although there would not be another explanation. By increasing sam- requency in other lysimeters, it was deter- hat indicator bacteria were killed off within lays at 60 C. The following toxic pollutants en added to the lysimeters: cyanide, phenols, c sludge, and some pesticides. (Baker-IVI)
826

LATION ECOLOGY OF ROTIFERS AS A SAY TOOL FOR ECOTOXICOLOGICAL IN AQUATIC ENVIRONMENTS,
art Univ. (Germany, F.R.).
bach, M. Siebert, M. Westermayer, and C.
icology and Environmental Safety, Vol. 7, p 484-513, October, 1983. 33 Fig, 23 Ref.

ptors: *Population dynamics, *Rotifers, say, Water quality, Monitoring, Toxicity, onus.

opulation dynamics of the monogonont ro- rachionus rubens were used under con- trolled experimental conditions as a sensitive bioassay for toxic substances in sublethal doses. Even slight reductions in organism fertility and life expectancy were reflected at the integrated level of population dynamics. Serving as bioindicators for the standard test are the population parameters intrinsic rate of natural increase (r), carrying capacity (k), frequency (f), and pregnancy of the density oscillations (p). The optimal spreading power (steepest slope of the response curves) lies at different concentration areas for each parameter, so that they can be used specifically in standard tests. (Author's abstract)
W84-01827

TOTAL ALKALINITY VERSUS BUFFER VALUE (CAPACITY) AS A SENSITIVITY INDICATOR FOR FRESH WATERS RECEIVING ACID RAIN,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
S. D. Faust.
Journal of Environmental Science and Health, Vol. A18, No. 5, p 701-711, September, 1983. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Alkalinity, *Acid Rain, *Water quality, Water pollution effects, Indicators, Acidity.

The frequently stated idea that total alkalinity is a measure of the buffer capacity of a natural water is refuted. Total alkalinity is a measure of the acid neutralizing capacity, equivalents/liter, of a water. In natural waters, the carbonate system provides most of this neutralizing capacity. In as much as the pH values of natural fresh waters lie below 8.3, the total alkalinity is, for all intents and purposes, the total bicarbonate content. Any contributions of carbonate and hydroxide to total alkalinity are nil. The buffer capacity or buffer value is the relation between the increment of a strong base, or strong acid, that causes a one unit change in the pH value. The values of total alkalinity and pH, considered individually cannot give an accurate assessment of the impact of acid deposition on a natural water. Rather it is necessary to combine the pH and alkalinity values into the beta concept in order to assess accurately and to calculate the capacity of a natural water to resist the impact of acid deposition. An analytical determination of total alkalinity is given with an application of the beta value. (Baker-IVI)
W84-01860

SIMPLE DETERMINATION OF OXIME CARBAMATES IN SOIL AND ENVIRONMENTAL WATER BY HIGH PRESSURE LIQUID CHROMATOGRAPHY,
Institute for Pesticide Research, Wageningin (Netherlands).
A. Dekker, and N. W. H. Houx.
Journal of Environmental Science and Health, Vol. B18, No. 3, p 379-392, June, 1983. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Soil analysis, Aldicarb, Oxamyl, Methomyl, High pressure liquid chromatography, Chromatography.

A method is described for determining residues of aldicarb, aldicarb sulfoxide, aldoxycarb, oxamyl and methomyl in soil, groundwater and surface water. Subsoils were extracted with water and topsoils were extracted with acetone. The aqueous samples were either directly injected after acidification or concentrated by extraction with chloroform. The organic extracts were evaporated to dryness and redissolved in acidified mobile phase. The compounds were detected with a variable wavelength U.V. detector or with a fluorometric detector after a post-column reaction. Compounds within a concentration range from 0.5 ng/ml to 200 ng/ml could be determined with a maximum coefficient of variation of 7.5%. Recoveries varied from 77.0 to 98.8%. (Baker-IVI)
W84-01861

UTILITY OF ENDOTOXINS AS A SURROGATE INDICATOR IN POTABLE WATER MICROBIOLOGY,
Illinois Inst. of Tech., Chicago. Dept. of Environmental Engineering.
C. N. Haas, M. A. Meyer, M. S. Paller, and M. A. Zapkin.
Water Research, Vol. 17, No. 7, p 803-807, July, 1983. 3 Tab, 12 Ref.

Descriptors: *Water quality, *Indicators, *Endotoxins, Coliforms, Bacteria, Potable water, Spectrophotometry.

Whether the measurement of gram-negative bacterial endotoxins could serve as a useful surrogate to the measurement of either total coliforms or standard plate count organisms to determine raw water quality was investigated. The LAL spectrophotometric assay of gram-negative bacterial endotoxin was used for the study. While statistically significant associations were noted between standard plate count, membrane standard plate count and total coliform organisms and total endotoxins, these were at a relatively low coefficient of determination. In the two water treatment and distribution systems studied, endotoxins were observed at levels between 3-14 micrograms/liter. There was little advantage found in the use of the free or bound (total-free) endotoxin analysis in correlating standard bacteriological parameters, and there may be some interference of an unknown nature between the LAL spectrophotometric endotoxic analysis and particulate material present in natural surface, partially treated, and finished potable water. From a practical point of view these findings do not justify the use of the LAL spectrophotometric procedure as a surrogate or rapid measurement of these classical parameters. (Baker-IVI)
W84-01898

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS - V; ORGANIC CARBONS AND HYDROCARBONS IN SEDIMENTS,
Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
G. Matsumoto.
Water Research, Vol. 17, No. 7, p 823-830, 1983. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Organic carbon, *Hydrocarbons, *Sediments, *Pollutant identification, *Sludge, *Wastewater, Japan, Tokyo, Tama River, Ogasawara Islands, Water pollution sources, Urban areas, Industrial wastes, Alkanes, Squalene.

Organic carbons and hydrocarbons were analysed for polluted sediments from Tama River and sludges from night soil and sewage treatment plants in the Tokyo area (Japan) and unpolluted sediments from river and reservoirs from Chichijima Island in the Ogasawara (Bonin) Islands to characterize their features for polluted and unpolluted aquatic environments. In addition the relationships of the features of organic consituents between waters and sediments were given. The contents of n-alkanes (C14-C36), squalane and unresolved complex mixture of hydrocarbons (UCMH) for the sediments from Tama River ranged from 16 to 94, 0.86-15 and 250-1100 micro g/g dry base, which are much higher than those of the sediments from Chichi-jima Island. The major constituents of hydrocarbons in the sediments and sludges from the Tokyo area were mainly odd-carbon numbered n-alkanes and squalene, whereas those of the island were only odd-carbon numbered n-alkanes. Hydrocarbons as carbon (total content x 0.851, as C20H42, HCC)/total organic carbon (TOC), HCC/extractable organic carbon with ethyl acetate (EOC), squalene as carbon (SqC)/TOC, SqC/EOC and UCMH/n-alkane (C15-C33) values for the sediments from Tama River were much higher than those of the sediments from the island, while carbon preference index (CPIH) values for the sediments of Tama River were considerably lower than those of the island. It was thus indicated that HCC/TOC, HCC/EOC, UCMH/n-alkane and CPIH values should be the important indicators of hydrocarbon pollution for aquatic environments. In addition SqC/TOC and SqC/EOC ratios are apparently useful measures of urban-industrial activities on

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aquatic environments. The similarity of the nature of hydrocarbons of sediments and sludges from the Tokyo area indicated that the sewage contributed considerably to urban river sediments. Further it was also indicated that hydrocarbons were concentrated in sedimentary environments, although the features of hydrocarbons in sediments are generally similar to those of waters. (Author's abstract)
W84-01899

POLLUTION LEVELS IN SOME NIGERIAN RIVERS,
Ibadan Univ. (Nigeria). Dept. of Preventive and Social Medicine.
P. A. Oluwande, M. K. C. Sridhar, A. O. Bammeke, and A. O. Okubadejo.
Water Research, Vol. 17, No. 9, p 957-963, 1983. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Pollution load, *Tropical regions, *Rivers, *Nigeria, Water temperature, Wastewater, Water pollution sources, Seasonal variation, Eutrophication, Oxygen, Supersaturation, Light, Bacteria, Water quality.

Surveys of five rivers in a hot-humid zone of a tropical country (Nigeria) were carried out over 3 years by obtaining samples for physical, chemical and bacteriological analyses. The main characteristics monitored were temperature, turbidity, total, dissolved and suspended solids, pH, dissolved oxygen, BOD, ammonia-nitrogen and the coliform counts. In addition, the main characteristics of the liquid waste being discharged into the rivers were determined. During the dry season, the highest mean temperature is 29 C with a range of 5 C and the lowest is 26 C with a range of 3 C. In the wet season, the highest mean temperature is 27.3 C with a range of 2 C while the lowest is 24.5 C with a range of 1 C. The other characteristics vary more widely with seasons. The high temperature in these rivers all the year round encourages pollution by human activities. During the dry season, pollution causes prolific algae boom, which causes oxygen supersaturation during periods of high temperature and abundant sunlight. The physical, chemical and biological characteristics of the rivers deteriorate sharply as they flow through towns annd other human communities. (Author's abstract)
W84-01905

IN SITU PERISTENCE OF INDICATOR BACTERIA IN STREAMS POLLUTED WITH ACID MINE DRAINAGE,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
N. E. Carlson-Gunnoe, C. B. Law, and G. K. Bissonnette.
Water Research, Vol. 17, No. 9, p 1119-1124, September, 1983. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Indicators, *Bacteria, *Acid mine drainage, Monitoring, Streams, Fecal coliforms, Coliforms, Streptococci, Domestic wastes.

Persistence of indicator organisms associated with natural samples of raw sewage was studied following in situ exposure to five aquatic environments. Three of these streams contained significant amounts of acid mine water while the other two were relatively uncontaminated. Indicator organisms were rapidly killed upon exposure to the acid mine systems, whereas little reduction in numbers was noted in the uncontaminated streams. Seasonal changes affected survival of indicators as reflected by prolonged persistence at colder in situ water temperatures. The fecal coliform group was most susceptible to the acid mine water stress, while the fecal streptococci were most persistent. An enrichment technique resulted in substantially enhanced recovery of certain species of sublethally injured survivors of acid stress. Enrichment was particularly beneficial for recovery of acid mine water injured fecal coliforms. Relatively little improvement in recovery of fecal streptococci was afforded by the enrichment technique. These findings suggest that dependence on coliform analyses may not be adequate for reliable determination of bacteriological water quality in acid streams. If coliforms are to be used for reliable determination of bacteriological water quality in acid streams, it would seem essential that enrichment techniques be used in order to recover sublethally injured survivors. (Baker-IVI)
W84-01911

STABILIZED TEMPERATURE PLATFORM FURNACE WITH ZEEMAN EFFECT BACKGROUND CORRECTION FOR TRACE ANALYSIS IN WASTEWATER,
Bodenseewerk Perkin-Elmer and Co., Uberlingen (Germany, F.R.).
U. Vollkopf, A. Grobenski, and B. Welz.
Atomic Spectroscopy, Vol. 4, No. 5, p 165-170, September-October, 1983. 14 Fig, 1 Tab, 7 Ref.

Descriptors: *Trace metals, *Pollutant identification, *Wastewater analysis, Cadmium, Lead, Chromium, Zeeman effect, Stabilized temperature platform furnace.

Conventional graphite furnace atomic absorption (AA) is often plagued by nonspectral as well as spectral interferences. This is particularly true in the determination of trace metals in complex matrices like wastewater. For the elimination of nonspectral interferences, the Stabilized Temperature Platform Furnace (STPF) concept was applied. To avoid spectral interferences caused by high and structured background, the Zeeman/5000 system was used. The results of the determination of Cd, Cr, and Pb in various wastewaters demonstrate that the application of the STPF concept provides an optimum environment for atomization in a graphite furnace. All of the STPF parameters must be applied to guarantee that the majority of determinations can be carried out free from vapor-phase interferences directly against reference solutions. Matrix modification and peak area integration are important integral parts of the complete concept. The combination of the STPF with Zeeman effect background correction permits in addition the direct determination of ultratrace amounts of metals even in complex matrices where extremely high or structured background plagues conventional graphite furnace AA. (Baker-IVI)
W84-01971

ANTHROPOGENIC ZINC AND CADMIUM BURDENS IN SEDIMENTS OF SELECTED SOUTHERN ONTARIO LAKES,
Trent Univ., Peterborough (Ontario).
For primary bibliographic entry see Field 5B.
W84-01973

ZINC, MANGANESE, AND STRONTIUM IN OPERCULA AND SCALES OF BROOK TROUT (SALVELINUS FONTINALIS) AS INDICATORS OF LAKE ACIDIFICATION,
Laval Univ., Quebec. CENTREAU.
For primary bibliographic entry see Field 5C.
W84-01980

TRACE DETERMINATION OF THE ANTIHISTAMINES TRIPELENNAMINE HYDROCHLORIDE, THENYLDIAMINE HYDROCHLORIDE, AND CHLOROTHEN CITRATE IN ADMIXTURE IN ANIMAL FEED, HUMAN URINE, AND WASTEWATER BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY AND USE OF A FLUORESCENCE DETECTOR,
National Center for Toxicological Research, Jefferson, AR.
H. C. Thompson, Jr., C. L. Holder, and J. R. Althaus.
Talanta, Vol. 30, No. 4, p 251-260, 1983. 4 Fig, 7 Tab, 21 Ref.

Descriptors: *Wastewater analysis, *Drugs, Chromatography, High-pressure liquid chromatography, Gas chromatography, Research facilities.

Tripelennamine hydrochloride, thenyldiamine hydrochloride, and chlorothen citrate have been used as antihistamines and for the treatment of asthma and bronchitis. Toxicological evaluation of these drugs was scheduled as part of a structure-activity relationship study of antihistamines in rats and mice, because of the paucity of such information. Prerequisite for the evaluation was the development of analytical chemical procedures to the concentration, homogeneity, and stab the drugs in dosed feed, to monitor the laboratory personnel to signal their possibl sure to the drugs, and to monitor the was to ensure that the test agents were not dis into the environment. A high-pressure liqui matographic procedure with fluorescence tion was developed for determination of th antihistamines in admixture in animal feed, urine, and wastewater at levels of 500, 10 ng/g, respectively. Data on the partition and use of a silica gel column to aid in the c of sample extracts from the three substra reported for the three test agents. Extracti ciencies and data concerning the stability o lennamine hydrochloride and thenyldiami drochloride in animal feed are presented. D tion of a new route for synthesis of chlo citrate and ancillary data concerning the ga matographic analysis for the three drugs in ture in animal feed at levels as low as 10 mic are also reported. (Author's abstract)
W84-02002

DETERMINATION OF TRACE AMOUN PHOSPHATE IN RIVER WATER BY F INJECTION ANALYSIS,
Okayama Univ. (Japan). Dept. of Chemistry.
S. Motomizu, T. Wakimoto, and K. Toei.
Talanta, Vol. 30, No. 5, p 333-338, 1983. 12 Tab, 23 Ref.

Descriptors: *Flow-injection analysis, phates, Water analysis, Spectrophotometry, ganic phosphates.

A flow-injection analysis system for the dete tion of trace amounts of phosphate in river has been developed. The phosphate is reacte molybdate and malachite green in acidic m to form a green species, the absorbance of w measured at 650 nm. A 0.00022 M malachite solution was found to give a good comp between sensitivity and base-line stability. the reagent is used for phosphorus concentr above 200 ng/ml, the complex becomes co tive and easily adsorbed on the surface tubing. The effect can be prevented by addi ethanol to the reagent. The optimal conditio a flow rate of 2.1 ml/min and a reagent cont 250 ml of ethanol, 70 ml of concentrated su acid and 0.11 mole of molybdenum per liter. phorus (as inorganic phosphate) can be deter at the level of several ng/ml in water. An can be done at a rate of up to 40 per hour. (M IVI)
W84-02003

SPECTROPHOTOMETRIC DETERMINA OF MICRO AMOUNTS OF NITRIT WATER AND SOIL,
Shaanxi Monitoring Station of Environmenta tection, Xian (China).
Q.-F. Wu, and P.-F. Liu.
Talanta, Vol. 30, No. 5, p 374-376, 1983. 2 Tab, 11 Ref.

Descriptors: *Spectrophotometry, *Ni *Water analysis, Interference, Sulfide.

A spectrophotometric method for determinati micro amounts of nitrite in water and soil is on diazotization of p-animoacetophenone foll by coupling with resorcinol in sodium carbo sodium acetate medium, to form a bright water soluble azo-dye. Foreign ions are m with a composite EDTA-sodium hexameta phate reagent. The interference of sulfide c eliminate by addition of mercuric chloride. law is obeyed up to 20 micro g of NO2(-) in of solution and the molar absorptivity at 435 52,700 l/m/cm. The color is stable for 1 Results obtained by using the proposed metho water and soil samples agree well with thos tained by the standard method. The limit of d tion of nitrite by this method is 0.005 micro (Moore-IVI)
W84-02004

ERMINATION OF MERCURY IN WATER ELECTRO-DEPOSITION AND LOW-PRES- E RING-DISCHARGE EMISSION SPEC- SCOPY,
sza Szkola Nauczycielska w Slupsku (Poland). . of Physics.
. Wrembel.
nta, Vol. 30, No. 7, p 481- 485, 1983. 5 Fig, 8 47 Ref. Polish Academy of Sciences grant I-15.

riptors: *Atomic emission spectroscopy, ctrodeposition, *Mercury, Water analysis, ater, Heavy metals, Spectroscopy.

application of low-pressure ring-discharge ic-emission spectroscopy, combined with elec- eposition on copper and platinum, to the de- nation of trace mercury in water has been tigated. Distilled water, artificial Baltic Sea r, artificial sea-water, and various natural rs were examined. The limit of detection was ng/l for distilled water, and 0.03 ng/l for cial Baltic Sea water. Better precision was ned with the platinum electrode, and the pre- was 1-4% for mercury concentrations great- an 10 ng/l. The precision was slightly worse ea-water samples. The sensitivity and preci- of the method show that it is generally appli- to assay for mercury in environmental rs. (Moore-IVI)
02005

CT OF ORGANIC MATTER AND COL- DAL PARTICLES ON THE DETERMINA- N OF CHROMIUM(VI) IN NATURAL ERS,
hu Univ., Fukuoka (Japan). Radioisotope r.
aki, T. Osaki, H. Hirashima, and Y. hima.
ta, Vol. 30, No. 7, p 523-526, 1983. 3 Tab, 19

riptors: *Chromium, *Solvent extraction, er analysis, Organic matter, Colloids, Chro- compounds, Seawater, Interference, Natural s.

hromium(VI) contents of two water samples, r water and a sea-water, were determined by s of solvent extraction with APDC (ammoni- yrrolidinedithiocarbamate) into chloroform y co-precipitation with iron(III) hydroxide. nalytical results depended on the separation d used, possibly because of differences in the ior of the chemical species of chromium in l waters. Various chromium species, includ- imple inorganic ions, organic complexes,) adsorbed on inorganic colloids and Cr(III) ned with organic polymers, were prepared, eir analytical characteristics were investigat- e chromium(III) species which contribute to ror of the analytical method for Cr(VI) could e identified. Unless the main Cr(III) species t in natural waters, and their characteristics, own, it is difficult to rule out the possibility large error in the determination of Cr(VI). re-IVI)
02006

RMINATION OF CHLORIDE, NITRATE, HATE AND TOTAL SULPHUR IN ENVI- MENTAL SAMPLES BY SINGLE- MN ION CHROMATOGRAPHY,
's Univ., Kingston (Ontario). Dept. of istry.
Hern, G. K. Rutherford, and G. W. on.
ta, Vol. 30, No. 9, p 677-682, 1983. 4 Fig, 6 6 Ref. DSS contract ISU80-00350.

iptors: *Ion chromatography, *Chlorides, tes, *Sulfates, *Sulfur, Water analysis, Rain, water analysis, Interstitial water.

-column ion chromatography using conduc- detection as well as an indirect ultraviolet que was applied to the determination of Cl(- 3(-) and SO4(2-) in samples of rain, sewer , and soil-pore water. Also described are two methods which allow ion chromatographic analysis of CaSO4-extractable nitrate in soils, and total sulfur in soils, marine sediments and plant tissue. Single-column ion chromatography is well suited to rapid, simultaneous analysis for anions in aqueous environmental samples. The relative simplicity and ease of operation are conducive to routine analysis, particularly with the availability of modern data-handling systems which can be directly interfaced with the detector. No interruption of operation is necessary to regenerate a suppressor column, and indirect ultraviolet detection provides lower detection limits than previously possible with conductivity measurements. Pretreatment with a lead-charged cation-exchange resin permits the analysis of samples high in SO4(2-). (Moore-IVI)
W84-02007

DETERMINATION OF CHROMIUM(VI) IN NATURAL WATERS BY THE SORPTION OF CHROMIUM-DIPHENYLCARBAZONE WITH XAD-2 RESIN,
Kyushu Univ., Fukuoka (Japan). Radioisotope Center.
S. Osaki, T. Osaki, and Y. Takashima.
Talanta, Vol. 30, No. 9, p 683-686, 1983. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Chromium, *Sorption, Water analysis, Organic matter, Natural waters, Seawater, Interference.

The sorption of the chromium(III)-diphenylcarbazone complex (Cr-DPC) with XAD-2 has been investigated, for use in the separation of Cr(VI) from Cr(III) species in natural waters. Cr-DPC is formed from the reaction of Cr(VI) with diphenylcarbazide, but Cr(III) species give no reaction in aqueous solution. The addition of sodium chloride or sodium beta-naphthalenesulfonate markedly enhances the sorption. The Cr-DPC sorbed on XAD-2 can be almost completely eluted with organic solvents, especially methanol, but about 5% of it is irreversibly sorbed and cannot be eluted. The excess of diphenylcarbazide and some of the organic matter in natural waters are also sorbed on XAD-2 but most of the this can also be eluted with methanol. Organic matter which interferes with measurement of the absorbance of Cr-DPC can almost all be removed by extraction and chloroform. By use of these techniques, Cr(VI) in seawater has been determined by the standard-addition method. Although about 50 l of sea-water are necessary for the analysis, organic and colloidal Cr(III) species do not interfere. (Author's abstract)
W84-02008

METHOD FOR RECOVERY OF ENTERIC VIRUSES FROM ESTUARINE SEDIMENTS WITH CHAOTROPIC AGENTS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Wait, and M. D. Sobsey.
Applied and Environmental Microbiology, Vol. 46, No. 2, p 379-385, August, 1983. 1 Fig, 6 Tab, 26 Ref. PHS grant AI17277, DOC grant NA79AA-D-00048.

Descriptors: *Chaotropes, *Enteric viruses, *Estuarine sediments, Poliovirus, Echovirus, Rotairus, Estuaries, Virus recovery.

An evaluation was made of the ability of chaotropes, low-molecular-weight ionic compounds which enhance the solubilization of hydrophobic compounds in water, to improve the recovery of enteric viruses from highly organic estuarine sediments. Chaotropic agents alone were poor eluents of polioviruses from sediment but were effective when combined with 3% beef extract. Chaotropes of lower potency, NaNO3, NaCl, and KCl, were more efficient eluents than the stronger chaotropes, guanidium hydrochloride or sodium trichloroacetate. The most effective eluent was 2 M NaNO3 in 3% beef extract at pH 5.5, which eluted 71% of sediment-associated polioviruses. Efficient concentration of the sodium nitrate-beef extract eluate by organic flocculation required the addition of the antichaotrope (NH4)2SO4 to a 2 M concentration and Cat-Floc T (Calgon, Pittsburgh, Pa.) a cationic polyelectrolyte, to a 0.01% concentration. Dialysis of the final concentrate was necessary to reduce salts to nontoxic levels before assay in cell cultures. Trials with highly organic estuarine sediment seeded with high or low numbers of poliovirus 1, echovirus 1, or rotarvirus SA-11 demonstrated the superiority of this method over two other methods currently in use. (Author's abstract)
W84-02056

FORMATION OF THE BROMINE-CONTAINING TRIHALOMETHANE IN WATER, ITS PREVENTION AND POSSIBILITY OF ELIMINATION; PART I: DETERMINATION OF BROMIDE AND IODIDE IN LOW CONCENTRATION (BILDUNG BROMHALTIGER TRIHALOMETHANE IM WASSER, IHRE VERHINDERUNG UND MOGLICHKEITEN DER ELIMINATION; I. MITT: BESTIMMUNG VON BROMID UND IODID IN SPURENKONZENTRATIONEN),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
M. Grandet, L. Weil, and K.-E. Quentin.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 2, p 66-71, 1983. 6 Fig, 4 Tab, 24 Ref.

Descriptors: *Bromide, *Iodide, *Gas chromatography, Trihalomethanes, Drinking water, Chlorination, Water treatment, Water analysis.

During oxidative treatment of drinking water (for example with chlorine), trihalomethanes are formed by the reaction between organic matter and the halogens present in water. This formation depends on the concentration of the halogens, which usually are present in microgram quantities. In order to gain an exact knowledge of the mechanism of this formation and the possibility of eliminating the haloforms it is necessary to qualitatively evaluate bromide and iodide in the microgram-range. A gas chromatographic method was developed which allows detection of 50 micro g/l bromide and 5 micro g/l iodide without concentration and 0.5 micro g/l bromide and 0.2 micro g/l iodide with sample concentration. The relatively simple procedure is based on the transformation of the halogens into 2-bromo- or 2-iodohydrine. These derivatives are extracted with ethylacetate and are determined with an electron capture detector. The different retention times between 2-bromo- and 2-iodohydrine make possible the determination of both of the halogens in one sample of water. This method is not subject to interference, which has been proven with water samples of different origin and composition. The method is recommended to be generally used for the determination of bromide and iodide in drinking water. (Moore-IVI)
W84-02065

CHEMICAL OXIDIZABILITY OF ORGANIC WATER POLLUTANTS (CHEMISCHE OXIDIERBARKEITEN ORGANISCHER WASSERINHALTSSTOFFE (ERGEBNISBERICHT)),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
W. Janicke.
Zeitschrifte fur Wasser und Abwasser Forschung, Vol. 16, No. 3, p 85-86, 1983. 26 Ref.

Descriptors: *Pollutants, *Chemical oxygen demand, *Waste water analysis, Analytical methods, Permanganate, Dichromate, Oxidation.

About 580 mostly organic compounds from all the important classes of substances, of synthetic and natural origin, were tested for chemical oxidizability. The method using permanganate (in acid solution) and dichromate/H2SO4 (without and with Ag+ as a catalyst) were applied in accordance with standard procedures and legislative prescriptions respectively, and the results thereof were compared with published values. The dichromate with Ag+ COD method reached oxidizabilities of nearly 100% of theory with most organic substances, and proved sufficient and adequate for the ingredients of most industrial effluents. In contrast, the permanganate-COD method mostly reaches only up to 10%, often equals 0% of the theory, and is therefore of no relevance. Comparing the 3

different oxidation methods used, the tested compounds may be classified into 4 categories of oxidation efficiency. The values of oxidizability are discussed in respect to the structural groups of the tested compounds. (Author's abstract)
W84-02066

SUBMERGED WATER PLANTS AS TESTING ORGANISMS FOR POLLUTANTS (SUBMERSE WASSERPFLANZEN ALS TESTORGANISMEN FUR BELASTUNGSSTOFFE),
TUV Stuttgart e.V., Filderstadt (Germany, F.R.).Warnetechnik und Umweltschutz.
W. Nobel, T. Mayer, and A. Kohler.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 3, p 87-90, 1983. 5 Tab, 13 Ref.

Descriptors: *Aquatic plants, *Bioindicators, *Toxicity, Water pollution effects, Ammonia, Chloride, Phosphates, Boron, Marlon A, Phenols, Heavy metals.

Results of pollution experiments with submerged vascular plants under controlled conditions in the laboratory are presented as results of toxicity tests. It is possible to use submerged macrophytes as biological indicators, especially as testing organisms for water-pollutants. The following substances show toxic effects to submerged macrophytes (first significant damage) in concentrations, which are relevant to the environment: ammonium (5 mg/l NH4), boron (1 mg/l B), chloride (50 mg/l Cl), phosphate (1 mg/l PO4), and Marlon A (0.5 mg/l MBAS). At less realistic concentrations for use as environmental indicators, first significant damages are found for different phenols (cresol 0.22 mg/l, xylenol 0.24 mg/l, phenol 0.56 mg/l), whereas first significant damages for complexed heavy metals occur at concentrations of partial use (copper 0.032 mg/l Cu, zinc 0.65 mg/l Zn, cadmium 0.011 mg/l Cd, lead about 2 mg/l Pb). (Moore-IVI)
W84-02067

ONE-DIMENSIONAL THIN LAYER CHROMATOGRAPHIC SEPARATION AND FLUOROMETRIC QUANTIFICATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN WATER SAMPLES (EINDIMENSIONALE DUNNSCHICHTCHROMATOGRAPHISCHE TRENNUNG UND FLUOROMETRISCHE BESTIMMUNG VON POLYCYCLISCHEN AROMATISCHEN KOHLENWASSERSTOFFEN AUS WASSERPROBEN),
Hygiene-Inst. des Ruhrgebiet, Gelsenkirchen (Germany, F.R.).
H. Schossner, W. Falkenberg, and H. Althaus.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 4, p 132-135, 1983. 3 fig, 3 Tab, 12 Ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Thin layer chromatography, Water analysis, Drinking water, Hydrocarbons, Wastewater analysis.

According to German drinking water regulations the quantitative analysis for 6 polycyclic aromatic hydrocarbons is necessary. The polycyclic aromatic hydrocarbon include benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, benzo(k)fluoranthene, fluoranthene, and benzo(g,h,i)perlene. The method consists of the separation of these substances by means of one-dimensional thin layer chromatography and fluorescence-spectroscopic quantitative evaluation using a computing integrator (SP 4100 Spectra-Physics). Samples of drinking water, surface water and waste water can be analyzed by this method. A clean-up of the extracts can be necessary before analyzing. (Moore-IVI)
W84-02071

REDUCTION OR SUBSTITUTION OF SILVER SULFATE USING THE STANDARD METHOD FOR CHEMICAL OXYGEN DEMAND (VERMINDERUNG ODER SUBSTITUTION VON SILBERSULFAT BEI DER CSB-STANDARD-METHODE),
Goettingen Univ. (Germany, F.R.). Inst. fuer Agrikulturchemie.
M. G. Eissa.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 4, p 136-138, 1983. 3 Tab, 6 Ref.

Descriptors: *Chemical oxygen demand, *Silver sulfate, Water analysis, Wastewater analysis, Nickel sulfate, Copper oxide, Oxalic acid.

The usual standard method (DEV) for chemical oxygen demand (COD) to determine the organic constituent of water and wastewater requires 10g of silver sulfate (Ag2SO4) to be used as an oxidation catalyst. Due to the relatively high dose and the high cost of silver, tests were made to find a way to cut down on the use of silver sulfate or replacing it altogether with either nickel sulfate (NiSO4) or copper oxide (CuO). The effects of comparative methods were tested on water specimens of various origin and on oxalic acid as a monitoring substance. The application of silver sulfate could be reduced to a tenth of the usual quantity without affecting the analytical results (average deviation = 0.6%). The two substitute catalysts, Ni-sulfate and copper oxide, produced, in comparison to Ag-sulfate, similar results when the organic constituent was above 100 mg/l O2 (average deviation = 1.60%). If the COD rate was below this level, the error percentage rose, and showed a negative correlation. It is possible to make use of these oxidation catalysts in areas where the COD is less than 100 mg/l O2, as long as the results can be adjusted by correlation. (Author's abstract)
W84-02072

SIMPLE METHOD FOR DETERMINING THE CATALASE ACTIVITY IN SLUDGE, SEDIMENT, AND WATER (EIN EINFACHES VERFAHREN ZUR BESTIMMUNG DER KATALASE-AKTIVITAT IN SCHLAMMM, SEDIMENT UND WASSER),
Stadtwerke Mainz A.G. (Germany, F.R.).
U. Obst, and H. K. Frank.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 4, p 138-139, 1983. 7 Ref.

Descriptors: *Catalase activity, *Electrochemistry, *Microorganisms, Sludge, Sediments, Water analysis, Aerobic metabolism, Hydrogen peroxide.

A simple electrochemical method is presented for determining the catalase activity of the microbial aerobic metabolism in sludge, sediment, and water. After adding hydrogen peroxide to the sample (final concentration of 0.5%) the catalytically produced oxygen is measured by an electrochemical process (Karlsruher Flasche). One to 5 minutes of reaction time permit an exact measurement. Non-biogenic decomposition of hydrogen peroxide is recorded by an inactivated sample. In examining various specimens of sludge, sediment, and water the method was reproducible and simple. Therefore an application is proposed for these purposes. (Author's abstract)
W84-02073

ANALYSIS OF PESTICIDES AND OTHER ORGANIC POLLUTANTS BY PRECONCENTRATION AND CHROMATOGRAPHIC TECHNIQUES,
Bari Univ. (Italy). Dept. of Chemistry.
A. Agostiano, M. Caselli, and M. R. Povenzano.
Water, Air and Soil Pollution, Vol. 19, No. 4, p 309-320, May 1983. 6 Fig, 6 Tab, 16 Ref.

Descriptors: *Pesticides, *Adsorption, *Tenax, *Chromatography, Gas chromatography, Thin layer chromatography, Halogenated pesticides, Carbamate pesticides, Organophosphorus pesticides, Aldrin, Water analysis.

The adsorption properties of Tenax have been studied in order to test the possibility of concentration and recovery of pollutant substances. Pesticides of various classes (chlorinated, phosphorated, carbamates, carbonates) and other organic toxicants having different volatility were employed as substances to be concentrated. They were present in water at 0.1 ppb level of concentration. Recovery was made by solvent extraction or by thermoe lution. Revelation and quantitative analysis wer performed by gas chromatography and b HPTLC. The effect of the flux was investigated Tenax is the most suitable material in comparison with other tested adsorbents. Recovery is general ly good except for aldrin. An apparatus for strip ping and thermoelution is described that allow one to analyze water and air pollutants. Procedure have been tested for single classes of substances o a mixture of them. (Author's abstract)
W84-02120

5B. Sources Of Pollution

TRANSVERSE MIXING IN WIDE AND SHAL LOW RIVER: CASE STUDY,
Rutgers - The State Univ., Piscataway. NJ. Dept of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W84-01773

BEHAVIOR OF ORGANIC COMPOUNDS DURING INFILTRATION OF RIVER WATER TO GROUNDWATER. FIELD STUDIES,
Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland).
R. P. Schwarzenbach, W. Giger, E. Hoehn, and J. K. Schneider.
Environmental Science and Technology, Vol. 17, No. 8, p 472-478, August, 1983. 6 Fig, 3 Tab, 42 Ref.

Descriptors: *Groundwater pollution, *Infiltration, *Groundwater recharge, Organic compounds, Path of pollutants, Chlorinated hydrocarbons, Switzerland.

Two field sites in Switzerland were used to study the behavior of organic micropollutants during infiltration of river water to groundwater. Persistent organic chemicals exhibiting octanol/water partition coefficients smaller than about 5000 moved rapidly with the infiltrating river water to the groundwater, a finding in agreement with predictions from model calculations. The biological processes which were responsible for the elimination of various micropollutants such as alkylated and chlorinated benzenes, occurred predominantly within the first few meters of infiltration. Alkylated benzenes were eliminated at faster rates than 1,4-dichlorobenzene. Anaerobic conditions in the aquifer near the river hindered the biological transformation of 1,4-dichlorobenzene. Among the compounds found to be persistent under any conditions were chloroform, 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene. With respect to such chemicals, bank infiltration is ineffective as a first step in the treatment of river water for water supplies. Long-term field measurements are useful to gain relevant insights into the behavior of organic micropollutants in a natural river water-groundwater infiltration system and to check the general validity of conclusions drawn from laboratory investigations. (Baker-IVI)
W84-01776

ACID RAIN: A RAPIDLY SHIFTING SCENE,
B. Hileman.
Environmental Science and Technology, Vol. 17, No. 9, p 401A-405A, 1983.

Descriptors: *Acid rain, *Policy making, Administrative decisions, Political aspects, Legislation, Water pollution sources.

Some changes are noted in the concern shown by top levels of the United States government regarding the problem of acid rain. A recent government report indicates that the problem is serious enough to warrant a search for immediate solutions, that emissions of sulfur dioxide and nitrogen oxides are at least 10 times greater from human activities than arises from natural happenings, that the areas receiving the highest deposition are within and downwind of the major source regions, and that some lakes in the major receptor areas have become more acidic in the past two decades. A National Research Council report agrees that the

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nt increase of acidic substances in the envi-
ent cannot be arising from natural causes. The
t concluded that there is no evidence for a
g nonlinearity in the relationship between
term average emissions and deposition. The
usion is based on analysis of historical trends,
nparison between the historical molar ratio of
dioxide and nitrogen oxides in emissions to
olar ratio of sulfates and nitrates in deposition
heoretical calculations based on lab studies of
hemical reactions involved in conversion of
xides to the sulfates and nitrates. Confidence
rrent mathematical models describing the
ment of acid-forming pollutants over long
ces is not high. Two types of models, the
M series and air shed model, incorporate a
icant number of gas phase reactions and
processes into an Eulerian grid calculation.
hese models have not been compared with
other or with simpler schemes. (Baker-IVI)
01777

CT OF SOLIDS CONCENTRATION ON SORPTIVE PARTITIONING OF HYDRO-BIC POLLUTANTS IN AQUATIC SYS-S,
gan Univ., Ann Arbor. Dept. of Civil Engi-g.
Voice, C. P. Rice, and W. J. Weber, Jr.
onmental Science and Technology, Vol. 17, , p 513-517, 1983. 6 Fig, 2 Tab, 15 Ref.

iptors: *Partition coefficients, *Organic com-s, Water pollution, Fate of pollutants, Partic- Organic carbon, Sediments, Lake Michigan, inated hydrocarbons, Naphthalene, Sorption.

on coefficients are commonly used to quanti- distribution of organic pollutants between queous and particulate phases of natural c systems. The magnitude of the partition cient for a specific pollutant in a particular has been shown to be related to the octa-ater partition coefficient of the pollutant and ganic carbon content of the solid phase onto sorption occurs. A third variable is impor-the concentration of the sorbing solid phase system. Laboratory partitioning experiments performed over a range of solids concentra-by using three different Lake Michigan sedi-samples as sorbents and four hydrophobic y pollutants (chlorobenzene, naphthalene, richlorobiphenyl, and 2,4,5,2',4',5'-hexach-phenyl) as sorbates. There is a significant se in partitioning as solids concentration de-s. Partition coefficients developed at one ntration of solids are not necessarily appro-at other solids concentrations, and partition cients produced in studies using different ques are not necessarily comparable. The effect is likely to occur in the environment gh the extent of the effect relative to that ed in the laboratory is unknown. (Moore-

1779

CE CONTRIBUTIONS TO ACID PRE-ATION IN TEXAS,
Univ. at Austin. Environmental Health En-ng Group.
eeley, and H. M. Liljestrand.
pheric Environment, Vol. 17, No. 4, p 807-83. 2 Fig, 3 Tab, 23 Ref.

ptors: *Precipitation, *Acid rain, *Texas, Prairie View, Highlands, Alkalinity, Am- Sulfuric acid, Spatial distribution, Salts.

recipitation-only sampling at Austin, Prairie nd Highlands, Texas, has been conducted in l to characterize sources of acid rain chemi-mposition. These results are compared with of previous investigators to identify spatial utions of source contributions. A chemical alance model is used to determine the spatial utions of background crustal source alkalini- sea salt contributions. Moisture from the f Mexico influences all three sites, as con- by bivariate analysis. Ammonia gas from ic/agricultural sources is found to be a poor against further acidification in areas of local acid emissions. There is a spatial distribution in background alkalinity from soil dust sources, with a 40 micro equiv/l alkalinity contribution to east Texas precipitation. Sulfuric acid is the predominant acid and shows a significant gradient away from coastal sources. (Moore-IVI)
W84-01783

TEMPORAL VARIATIONS IN ACID PRECIPITATION OVER NEW YORK STATE-WHAT THE 1965-1979 USGS DATA REVEAL,
Consolidation Coal Co., Pittsburgh, PA.
R. A. Bilonick, and D. G. Nichols.
Atmospheric Environment, Vol. 17, No. 6, p 1063-1072, 1983. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Acid rain, *Precipitation, *Statistical analysis, Temporal distribution, Hydrogen ion concentration, Sulfates, Nitrates, Calcium, Conductivity, Ion balance.

During the period from 1965 to 1979, the USGS collected rainfall samples throughout New York State. pH, sulfate, nitrate and calcium levels were measured, among other species. The statistical nature of the variation of these quantities with time was examined in this study. A preliminary step involved using ion balances and electrical conductivities to remove inconsistent measurements, which successfully reduced the amount of noise in the data. The time series analysis method of Box and Jenkins was applied: the results indicate that the long-term mean levels of hydrogen, sulfate, nitrate and calcium ion in the bulk (wet plus dry) precipitation samples were essentially constant. Use of the Box-Jenkins method was appropriate because samples that were collected close together in time were clearly more alike than those far apart, indicating autocorrelation. An analysis that fails to take this dependency into account could lead to incorrect conclusions. (Author's abstract)
W84-01784

ACID CLOUDS AND PRECIPITATION IN EASTERN COLORADO,
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Weather Research and Modification.
C. T. Nagamoto, F. Parungo, R. Reinking, R. Pueschel, and T. Gerish.
Atmospheric Environment, Vol. 17, No. 6, p 1073-1082, 1983. 7 Fig, 3 Tab, 10 Ref.

Descriptors: *Clouds, *Acid rain, *Acid precipitation, Weather patterns, Snow. Hydrogen ion concentration, Seasonal variatic olorado, Denver.

Rain and snow samples were collected at the eastern foothills of the Rocky Mountains and analyzed for chemical composition. Many precipitation samples had pH values considerably more acidic than the 5.6 value of pure water containing only an equilibrium amount of atmospheric CO2. The averages of pH for rain and snow are 4.8 and 5.5, respectively. Approximately 80% of the snow samples show pH $>$ 5.5. Clear and considerable dependencies of the acidity on seasonal synoptic scale weather patterns are demonstrated. The most acidic snow or rain in winter is prefrontal or frontal precipitation derived from deep low-pressure centers tracking across or just to the south of Colorado. The most acidic summer precipitation occurs with patterns similar to these but weaker, and with synoptic conditions conducive to isolated but relatively deep convection. Cloud water samples, collected by aircraft over eastern Colorado, also showed low pH values. The acidity of clouds was greatest near the city of Denver. Samples collected over east Denver showed pH = 3.3, indicating that the city is a major source of the acid clouds in the area. Organic anions appeared in the samples taken near the city, but not in remote samples. (Moore-IVI)
W84-01785

MOVEMENT OF TYPHOID ORGANISMS IN SATURATED PERMEABLE SOIL,
Washington Univ., Seattle. School of Public Health and Community Medicine.
J. A. McGinnis, and F. DeWalle.
Journal of the American Water Works Association, Vol. 75, No. 6, p 266-271, June, 1983. 2 Fig, 3 Tab, 48 Ref.

Descriptors: *Typhoid fever, *Groundwater pollution, *Shallow wells, Septic tanks, Salmonella, Soil porosity, Saturated soils, Public health, Groundwater movement, Water table, Drinking water, Yakima, Washington.

An outbreak of typhoid fever occurred during May 1972 in Yakima County, Washington, involving groundwater transmission of Salmonella typhi between a septic tank and a nearby shallow well. The distance between the septic tank and the well was 64 m, greater that the 30-m separation considered safe sanitary practice for septic tank design in the state of Washington. Individual soil characteristics, the direction of groundwater flow, and the velocity of groundwater flow should be considered in planning a shallow well located down the hydrologic gradient from a leach field. In a high porosity soil, a 30-m separation is probably unsafe. Where highly porous soils and fluctuating water tables provide poor filtration of sewage effluent, as in the rural setting of the town of Yakima, chlorinated community potable water systems are safer than unchlorinated individual wells. (Moore-IVI)
W84-01787

ENVIRONMENTAL STUDIES OF ENTERIC BACTERIA LONGEVITY IN MEMBRANE FILTER CHAMBERS,
National Water Research Inst., Burlington (Ontario). Analytical Methods Div.
For primary bibliographic entry see Field 5D.
W84-01804

HERBICIDE RUNOFF FROM EXPERIMENTAL WATERSHEDS,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
T. L. Wu, D. L. Correll, and H. E. H. Remenapp.
Journal of Environmental Quality, Vol. 12, No. 3, p 330-336, July-September, 1983. 4 Fig, 4 Tab, 19 Ref. EPA grant R804536-01.

Descriptors: *Atrazine, *Alachlor, *Herbicides, *Water pollution sources, Nonpoint pollution sources, Path of pollutants, Agricultural runoff, Agricultural watersheds, Pesticide residues, Rhode River Watershed, Maryland.

Two commonly used herbicides in corn fields of the Rhode River Watershed (Maryland) were atrazine (2-chloro-4-ethylamino-6-iso-propylamino-1,3,5-triazine) and alachlor (2-chloro-2',6'-diethyl-N-methoxymethyl acetanilide). Although alachlor was applied in larger quantities, atrazine was detected more frequently in runoff waters and had greater concentrations than alachlor (0-4 micro g/L vs. 0-6 micro g/L). Atrazine was more persistent and more mobile in watershed soils. Linear regression analysis of herbicide loading rates and percentage agricultural landuse did not give a direct relationship. Runoff waters from forest watersheds where herbicides were not directly applied, were contaminated with herbicides. During the 3-y study period (1976-1978), a maximum of 10 micro g/L of atrazine, and up to 0.5 micro g/L alachlor were discharged in winter runoff waters from the eight experimental watersheds. In addition to quantity of herbicides directly applied to land surface, residual levels in runoff waters must be influenced by other important factors such as topography, location of croplands in relationship to drainage channel, etc. A major portion of atrazine was found in dissolved aqueous form in runoff-water samples collected during storm events. Percolation in subsurface flow and dissolution in overland flow were believed to be important transport mechanisms. (Author's abstract)
W84-01806

HYDROLOGY AND SOIL LOSS FROM A HIGH-FERTILITY, ROTATIONAL PASTURE PROGRAM,
Science and Education Administration, Coshocton, OH.

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For primary bibliographic entry see Field 4C.
W84-01807

NITROGEN LOSS FROM A HIGH-FERTILITY, ROTATIONAL PASTURE PROGRAM,
Science and Education Administration, Coshocton, OH.
L. B. Owens, R. W. Van Keuren, and W. M. Edwards.
Journal of Environmental Quality, Vol. 12, No. 3, p 346-350, July-September, 1983. 3 Fig, 5 Tab, 17 Ref.

Descriptors: *Grazing, *Pasture management, *Water pollution sources, *Cattle, Agricultural runoff, Agricultural watersheds, Nonpoint pollution sources, Storm seepage, Nitrogen, Fertilizers, Nitrates, Ohio.

A beef cattle-pasturing system involving four rotationally grazed summer pastures (SG) and four pastures used rotationally for winter grazing/feeding (WGF) was studied on sloping upland watersheds in Ohio to determine effects of livestock management on N levels in water. Both summer and winter areas annually received 224 kg N/ha as NH4NO3 fertilizer. Surface runoff was collected automatically during runoff events, and subsurface flow was sampled from spring developments on a weekly basis. Although seasonal N concentration and transport in surface runoff tended to be greater in the area occupied by the cattle, N concentration and transport in runoff from the two areas were quite similar and did not significantly impair water quality, based on U.S. Public Health Standards. The NO3-N concentration in the subsurface flow from the WGF area was higher than in the subsurface flow from the SG area. The NO3-N concentration in the subsurface flow from both areas increased progressively throughout the study period, and reached levels as high as 18 mg/L. The subsurface flow provided the main pathway for N transport, with the surface transport being approximately 20 and 14% of the total N transport from the SG and WGF areas, respectively. The amount of sediment-N transported was very small because of low soil loss. (Author's abstract)
W84-01808

STREAM WATER QUALITY OF TWO SMALL WATERSHEDS AS AFFECTED BY SURFACE COAL MINING,
Ohio Agricultural Research and Development Center, Wooster.
W. A. Dick, J. V. Bonta, F. Haghiri, and J. R. Page.
Journal of Environmental Quality, Vol. 12, No. 3, p 351-358, July-September, 1983. 5 Fig, 8 Tab, 16 Ref. BM contracts J0166054 and J0166055.

Descriptors: *Coal mines, *Strip mines, *Water pollution sources, Water quality, Land reclamation, Suspended solids, Manganese, Hydrogen ion concentration, Flow rate, Heavy metals, Ohio.

Two small watersheds in eastcentral Ohio were selected for investigation of stream water quality prior to, during, and after surface coal mining and reclamation. Watershed C06 contained sandstone and shale overburden, and Watershed M09 contained limestone, sandstone, and shale. Water quality was monitored by measuring 39 parameters in the stream-water samples collected. Duration curves for the four parameters regulated by the Office of Surface Mining (OSM) showed that most samples collected from the two study watersheds exceeded the 70 mg/L regulation level for suspended solids concentration. Approximately 50 and 30% of the water samples collected at Watershed C06 during the mining and reclamation period and the post-reclamation period, respectively, exceeded the regulation level (4000 micro g/L) for manganese (MN). Twenty percent of the pH values at Watershed C06 during the mining and reclamation period were also below the lower regulation level (pH 6). Concentrations of the major cations and anions, suspended solids, and dissolved solids were correlated with flow rate (log values) during the premine and post-reclamation periods. Samples collected at similar flow rates at Watershed M09 showed concentrations of parameters were either not significantly affected or decreased in the post-reclamation samples, compared with the premine samples. A similar comparison for samples collected at the C06 watershed showed parameter concentrations were generally higher during the post-reclamation period. Parameters which were not detected in any samples collected from the two watersheds were arsenic (As), chromium (Cr) VI, mercury (Hg), and sulfide (S(2-)), while cyanide (CN(-)) was not detected at M09. Parameters that were only rarely detected were antimony (Sb), cadmium (Cd), lead (Pb), zinc (Zn), silver (Ag), copper (Cu), phenols, and phosphorus (P). (Author's abstract)
W84-01809

PCB PARTITIONING IN SEDIMENT-WATER SYSTEMS: THE EFFECT OF SEDIMENT CONCENTRATION,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
L. M. Horzempa, and D. M. Di Toro.
Journal of Environmental Quality, Vol. 12, No. 3, p 373-380, July-September, 1983. 12 Fig, 3 Tab, 24 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Sorption, Montmorillonite, Partition coefficients, Adsorption isotherms, Fate of pollutants, Lake sediments, Suspended particulates, Saginaw Bay, Michigan.

The effect of sediment concentration variations on polychlorinated biphenyl (PCB) sorption to natural lake sediment (Saginaw Bay, Mich.) and montmorillonite clay has been investigated. In studies utilizing tritiated 2,4,5,2',4',5'hexachlorobiphenyl (HCBP), partition coefficient values for adsorption isotherms (pi) were found to increase as sediment concentrations (m) were decreased from m = 1000 mg/L to m = 50 mg/L. HCBP adsorption to montmorillonite (m = 1000 mg/L, pi = 2900 L/kg; m = 50 mg/L, pi = 10 600 L/kg) appeared to be more sensitive to sediment concentration than did adsorption to the Saginaw Bay sediment (m = 1000 mg/L, pi = 9900 L/kg; m = 50 mg/L, pi = 17,100 L/kg). Evidence suggests that these variations are not the result of nonlinear isotherms. Although variations in solution chemical composition and kinetic effects were found to affect partitioning, neither factor appeared to adequately account for the magnitude of the observed sediment concentration effect. In experiments in which sediment concentrations were decreased (m = 1000 mg/L to 10 mg/L) while equilibrium aqueous HCBP concentrations were maintained at approximately constant levels, pi values for adsorption increased. The behavior was in conformity with the isotherm results. The observed behavior might be due to direct solid phase interactions between suspended particles. The occurrence of such interactions in natural waters could have potentially significant implications for efforts to predict sediment-water PCB distributions. (Author's abstract)
W84-01811

LOSS OF FALL-APPLIED 2,4-D IN SPRING RUNOFF FROM A SMALL AGRICULTURAL WATERSHED,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
W. Nicholaichuk, and R. Grover.
Journal of Environmental Quality, Vol. 12, No. 3, p 412-414, July-September, 1983. 1 Tab, 11 Ref.

Descriptors: *Herbicides, *Snowmelt, *Agricultural runoff, Surface runoff, Water pollution sources, Nonpoint pollution sources, Pesticide residues, Wheat, Saskatchewan.

The loss of 2,4-D (2,4-dichlorophenoxyacetic acid) applied in fall to wheat (Triticum aestivum L.) stubble on fields of Wood Mountain loam soil in semiarid southwestern Saskatchewan was measured in surface runoff from snow. The range of runoff volumes over the 6-y period was representative of runoff observed over a 30-y period at the same location. The loss of 2,4-D was greater from the treated stubble compared with fallow, which served as the control. The average loss from the control of 1.3 g/ha gives an indication of background limits that can be expected if 2,4 applied a year earlier. The 2,4-D loss in sno runoff is similar to losses in rainfall runoff severe storm soon after application. The 6-y age loss was 4.1% of the amount applied (0. ha). Correlation analysis showed that amo loss to be a function of runoff. The average weighted mean concentration of 31 micro g/ well below the USEPA maximum permissibl of 100 micro g/L, and slightly above the National Academy of Sciences and National emy of Engineering objective of 20 micro g drinking-water standards. (Author's abstract)
W84-01812

SEAGULL POLLUTION OF RESERVOIRS
Strathclyde Regional Council, Glasgow land). Water Dept.
C. Benton.
Journal of the Institution of Water Enginee Scientists, Vol. 37, No. 4, p 347-363, August, 6 Fig, 4 Tab, 30 Ref.

Descriptors: *Reservoirs, *Water pol sources, *Seagulls, *Bacteria, Feces, Salmo Water pollution control, Chlorination, Sco Strathclyde.

Microbiological surveys of untreated wa service reservoirs in Strathclyde Regions in land revealed a deterioration in bacterial q during storage. In a three-year study the s reservoirs supplying Loch Katrine water to gow were shown to be contaminated by (Larus sp) nocturnally roosting on the reservo winter. Significant correlations were mad tween the number of roosting gulls and the bers of E. coli present in the untreated res water. In addition, similar salmonellae orga of identical serotypes were isolated from the the untreated water and, on three occasions, the treated water. Occlusion of bacteria by pa late avian fecal matter rendered marginal chl tion of up to 0.2 ml/l of free chlorine re ineffective. Subsequently, the routine broadc by loud speaker of species specific distress c Larus gulls proved to be effective in discour gulls from roosting on the reservoirs. The pearance of the gulls resulted in improved quality. Water in the reservoirs at Helens was also found to suffer deterioration in bac quality during storage. These reservoirs were ied over a three-month period to compar effect of diurnal and nocturnal gull populatio water quality. Limited scaring was attempt this site, and the results showed favorable imp ments in water quality. (Baker-IVI)
W84-01823

POLYCHLORINATED BIPHENYL PO TION FROM SHIPBUILDING IN NAGA BAY, JAPAN,
Ehime Univ., Matsuyama (Japan). Dept. of ronment Conservation.
K. Maruyama, M. Sahrul, S. Tanabe, and R. Tatsukawa.
Ecotoxicology and Environmental Safety, V No. 5, p 514-520, October, 1983. 3 Fig, 3 T Ref.

Descriptors: *Polychlorinated biphenyls, * *Industrial wastes, Ships, Water pollution so Bioaccumulation, Japan, Nagasaki Bay.

Polychlorinated biphenyl (PCB) concentra were determined in sediment, in water, a biological samples from Nagasaki Bay, J PCBs were detected in all samples, with hi concentrations more than 10 micrograms/g, found in three sediment samples located nea shipyard drains. In general, PCB concentratio sediments and organisms tended to increase to the inner part of this bay. PCB isomer and c ner compositions in organisms as well as sedi were composed mainly of higher chlorinate phenyls and almost similar to Kanechlor 50 600 products (chlorine content 54 and 60% spectively) that have been used for ship p These results strongly suggest that shipbuildi primarily responsible for the PCB pollution i

ki Bay. Bioaccumulation factors of PCBs were erent among the organisms according to their hic levels. This might be a result of the pre-inant PCB transfer through the food chain in nisms and the discharge of bioaccumulative s as higher chlorinated biphenyls from ship-s. The PCB pollution from shipbuilding may inue for a long time due to the accumulative acteristics of PCBs used for ship paints and the ier discharge by scraping the old paints in yards. (Baker-IVI)
-01828

NCENTRATIONS AND SPECIATION OF D, ZINC, AND CADMIUM IN SEAWATER-E SMELTER EFFLUENT AND ADJACENT RINE ENVIRONMENTS, PORT PIRIE, TH AUSTRALIA,
mmonwealth Scientific and Industrial Research nization, Parkes (Australia). Baas Becking biological Lab.
rguson.
ralian Journal of Marine and Freshwater Re-h, Vol. 34, No. 3, p 375-385, 1983. 3 Fig, 5 9 Ref.

riptors: *Tidal channels, *Metals, *Metal-fin-g wastes, Marine environment, Industrial er, Lead, Zinc, Cadmium.

concentrations of particulate and dissolved zinc and cadmium (total dissolved Pb, 750 ograms/liter; Zn, 4300 micrograms/liter; Cd, nicrograms/liter; particulate Pb, 236 micro-s/liter; Zn 64 micrograms/liter; Cd < 1 mi-rams/ liter) occur in seawater-like effluent a lead-zinc smelting complex at Port Pirie. effluent is discharged through a silled tidal nel into the offshore marine environment, e dilution by seawater eventually reduces the l concentrations to values similar to those in surface seawater in Spencer Gulf, remote centers of industrial activity (average total lved Pb, 0.4 micrograms/liter; Zn, < 10 mi-rams/liter; Cd, 0.3 micrograms/liter; average culate Pb, < 0.05 micrograms/liter; Zn, 0.2 ograms/liter). Precipitation of dissolved s or conversion of originally weakly com-d dissolved metals to more strongly com-d species does not occur to a significant t. Particulate metal concentrations are influ-d by resuspension of metal-rich sediments and ptake of dissolved cadmium by unicellular that grow in the tidal channel. (Author's act)
01838

ORETICAL EXPLANATION OF SOLUTE ERSION IN SATURATED POROUS IA AT THE DARCY SCALE,
na Univ. at Bloomington. Dept. of Mathemat-

rimary bibliographic entry see Field 2F.
01887

ENT OF REVERSIBILITY OF POLY-ORINATED BIPHENYL ADSORPTION,
attan Coll., Bronx, NY. Environmental Engi-ng and Science Program.
Horzempa, and D. M. Di Toro.
r Research, Vol. 17, No. 8, p 851-859, 1983. 9 4 Tab, 24 Ref. EPA grants CR805229, 7853.

riptors: *Polychlorinated biphenyls, *Adsorp-*Desorption, *Lake sediments, Fate of pollut-Montmorillonite, Kaolinite, Clay, Isotherms, chlorobiphenyl, Partition coefficients, Sedi-, Michigan, Lake Huron, Saginaw Bay.

xtent of reversibility of PCB (polychlorinat-phenyl) bonding to sediments has been char-zed in studies on the partitioning behavior of achlorobiphenyl isomer. Linear non-singular rms have been observed for the adsorption lesorption of 2,4,5,2'4',5' hexachlorobiphenyl P) to 1100 ppm sediment suspensions. Parti-oefficients, pi(1/kg), for desorption from lake ents (Saginaw Bay, Lake Huron, Michigan) ubstantially greater (pi sub d about 20,000-35,000) than those obtained for adsorption (pi sub a about 9000-14000). HCBP was found to be more weakly adsorbed to montmorillonite (pi sub a about 3000, pi sub d about 9000) and kaolinite (pi sub a about 1000, pi sub d about 3000) clay samples than to the natural sediment samples. Desorption results (pi sub d) for Saginaw Bay sediments were quite similar to pi values (15,000-35,000) calculated from field measurements of aqueous and particulate PCB concentrations. For Saginaw Bay sediments and clay minerals partitioning appeared to be correlated both to sediment surface area and to sediment organic content. A regression analysis using both of these variables explained approximately 90% of the observed variations. HCBP adsorption at 40 degrees C (pi sub a about 14,000) was significantly greater than at 1 degree C (pi sub a about 6500) resulting in a calculated enthalpy of adsorption of +3.3 kcal/mol. Non-singular isotherm behavior was not found to be readily attributable to microbiological, kinetic or experimental effects. Evidence from consecutive desorption studies suggests that while HCBP adsorption may ultimately be reversible, release from sediments appeared to involve desorption along two distinct isotherms. These results have been interpreted in terms of possible similarities between the sorption properties observed in the distilled water systems of the present study and PCB bonding processes in natural water systems. (Author's abstract)
W84-01901

STREAM WASTE ASSIMILATIVE CAPACITY ANALYSIS USING REAERATION COEFFICIENTS MEASURED BY TRACER TECHNIQUES,
Hawaii Univ., Honolulu. Dept. of Civil Engineering.
C. C. K. Liu, and Y-S. Fok.
Water Resources Bulletin, Vol. 19, No. 3, p 439-445, June, 1983. 6 Fig, 4 Tab, 19 Ref.

Descriptors: *Assimilative capacity, *Reaeration, *Gas tracers, Tracers, Aeration, Water quality, Model studies, Canandaiqua Outlet, New York.

Atmospheric reaeration is one of the most important natural processes which determine the waste assimilative capacity of a receiving water. Values of reaeration coefficient used in the receiving water modeling analysis strongly influence the allowable wastewater treatment levels of potential point sources discharging into this water. Stream water quality models are developed with reaeration coefficients (K2) estimated by predictive equations, which leads to uncertainties in modeling analysis because these equations are empirical in nature and may yield greatly different K2 values for the same stream. The validity of a stream model would be enhanced significantly if K2 could be determined directly and reliably. Values of K2 in the Canandaiqua Outlet in Central New York have been measured by using a gas tracer method. A successful modeling analysis was conducted using these K2 values. As a result, effluent limitations of several waste water discharges into the Outlet were established. Field measurements of reaeration rate would improve modeling results significantly, and the gas tracer method can be easily incorporated into intensive water quality surveys normally required for stream modeling. (Moore-IVI)
W84-01929

DYNAMIC BACTERIAL MODEL FOR A RECREATIONAL LAKE,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Sciences.
C. G. Uchrin, and W. J. Weber, Jr.
Water Resources Bulletin, Vol. 19, No. 4, p 581-584, August, 1983. 5 Fig, 7 Ref.

Descriptors: *Bacteria, *Water pollution sources, *Fate of pollutants, Mathematical models, Simulation, Storm runoff, Wastewater, Reservoirs, Nonpoint source pollution, Ford Lake, Michigan.

A dynamic mathematical model was constructed to examine bacterial contamination problems affecting Ford Lake, a small recreational lake in Southeast Michigan. Ford Lake is a Huron River impoundment resulting from backwater caused by Ford Dam. The model was calibrated and verified using summer dry weather averaged data and data from three wet weather surveys. Model simulations demonstrated that the major bacterial contamination was attributable to storm related perturbations affecting two point sources: the Huron River and the Ypsilanti Sewage Treatment Plan. The nonpoint source contribution was relatively minor. Ford Lake serves as an effective bacteriological sink for pollutant loadings from point and nonpoint source inputs. Most of the resultant stress is confined to the upstream segments of the lake. The lake generally reverts to dry weather, steady state conditions within a week. Even under worst cases the lake exhibits negligible bacterial impact downstream. The model is currently being used by the State of Michigan Department of Natural Resources as a management tool by assessing the effectiveness of planned pollution abatement strategies. (Moore-IVI)
W84-01943

MODELING GROUND-WATER FLOW AT LOVE CANAL, NEW YORK,
GeoTrans, Inc., Reston, VA.
J. W. Mercer, L. R. Silka, and C. R. Faust.
Journal of Environmental Engineering, Vol. 109, No. 4, p 924-942, August, 1983. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Love Canal, New York, Geohydrology, Computer models, Lockport Dolomite, Interceptor wells, Water pollution control, Groundwater pollution.

A ground-water modeling study was conducted at the Love Canal area, Niagara Falls, New York, as part of a comprehensive evaluation of contamination at the area. The hydrogeology underlying Love Canal consists of a shallow system of silts and fine sands, underlain by confining layers of lacustrine clays and glacial till, which are underlain by the Lockport Dolomite. A two-dimensional computer model of the Lockport Dolomite was constructed to help define the ground-water flow system. Both history matching and a sensitivity analysis were conducted. Assuming the dolomite was contaminated, Monte Carlo simulation and uncertainty analysis were used to estimate contaminant travel times to the upper Niagara River. Results indicate that travel times would average 1,000 days with less than 5% probability of less than 100 days or greater than 10,000 days. Analysis of remedial action for the Lockport Dolomite using best estimates of hydrologic parameters indicates that three interceptor wells at the south end of the canal, pumped at only 1,155 cu ft/day (32.3 cu m/day), should reverse the flow of ground water to the river and provide an adequate barrier to migration of potential contaminants to the river. (Author's abstract)
W84-01956

ANTHROPOGENIC ZINC AND CADMIUM BURDENS IN SEDIMENTS OF SELECTED SOUTHERN ONTARIO LAKES,
Trent Univ., Peterborough (Ontario).
H. E. Evans, P. J. Smith, and P. J. Dillon.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 5, p 570-579, May, 1983. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Cadmium, *Zinc, *Lake sediments, Lead, Heavy metals, Water pollution sources, Watershed area, Replenishment, Atmosphere, Ontario.

The concentrations of Cd and Zn were measured in the sediments of 10 softwater lakes in southern Ontario. Elevated Cd and Zn levels were present in the recently deposited sediments of all the lakes, despite the absence of local point-source inputs. Whole-lake anthropogenic Zn and Cd burdens, calculated by prorating site-specific burdens according to the ratio of the site-specific Pb burden to the whole-lake Pb burden, range between 322 and 617 mg/sq m for Zn and between 6.2 and 11.3 mg/sq m for Cd. There were no significant differences in anthropogenic Zn or Cd burdens between

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lakes. The lack of a relationship between Zn or Cd burdens and the ratio of watershed area to lake area or the water replenishment time of the lakes indicates that deposition from the atmosphere directly onto the lakes surfaces is an important input of these metals to the lakes. (Author's abstract)
W84-01973

EFFECT OF ATMOSPHERIC SULFUR ON THE COMPOSITION OF THREE ADIRONDACK LAKES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, C. L. Schofield, N. E. Peters, G. R. Hendrey, and E. R. Altwicker.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 6, p 799-806, June, 1983. 8 Fig, 2 Tab, 18 Ref.

Descriptors: *Water pollution sources, *Atmospheric deposition, *Oligotrophic lakes, *Sulfur, Forest watersheds, Ammonia, Nitrates, Chloride, Alkalinity, New York, Panther Lake, Woods Lake, Sagamore Lake.

Three watershed-lake systems of the Integrated Lake-Watershed Acidification Study (ILWAS) were investigated to determine the effects of atmospheric deposition on the chemical compositions of oligotrophic lakes. Panther, Woods, and Sagamore lakes are in the Adirondack State Park, New York. The watersheds are forested with a mixture of hard and soft woods and have areas of 1.24, 2.07, amd 49.7 sq km, respectively. Annually, about 90% of the NH4(+) and 50% of the NO3(-) from atmospheric deposition were retained in the systems. In the Woods system, Cl(-) was in steady state with respect to atmospheric deposition although both Panther and Sagamore systems had net losses, indicating watershed sources of Cl(-). The losses of base cations from Panther and Sagamore were substantially greater than from the Woods system, reflecting the shallow soils of the latter. The concentrations of SO4(2-) in the waters of the three systems were controlled by the atmospheric deposition of anthropogenic sulfur; in Woods and Panther, inputs (atmospheric deposition) equalled outputs (discharges from the lake outlets); in Sagamore, outputs exceeded inputs. In 1978-80, concentrations of SO4(2-) were four to five times higher than historical values. These increased concentrations had caused either decreased alkalinities of surface waters or increased concentrations of base cations or both. Decreased alkalinity directly affects aquatic ecosystems; increased concentrations of base cations directly affect terrestrial ecosystems because of increased rates of loss of the nutrients Ca, Mg, and K in the absence of resupply from primary weathering. (Moore-IVI)
W84-01976

INFLUENCE OF SEWAGE TREATMENT AND URBANIZATION ON SELECTION OF MULTIPLE RESISTANCE IN FECAL COLIFORM POPULATIONS,
Oxoid Canada, Inc., Nepean (Ontario).
J. B. Bell, G. E. Elliott, and D. W. Smith.
Applied and Environmental Microbiology, Vol. 46, No. 1, p 227-232, July, 1983. 6 Tab, 25 Ref.

Descriptors: *Coliforms, *Antibiotic resistance, *Wastewater treatment, Wastewater lagoons, Fecal coliforms, Urban areas, R factors, Effluents, Water quality, Wastewater management, Slave River, Red River, Canada.

The fecal coliform populations found in the raw sewages and final sewage effluents of mechanical treatment plants, a long-term retention lagoon, shorter-term retention lagoons, a remote northern Canada river, and a heavily urbanized prairie river were examined for antibiotic resistance and the possession of R factors. It was determined that there was a decrease in the percentage of multiresistant fecal coliform populations in the mechanical sewage treatment plants and shorter-term retention lagoons; however, there was an increase in populations from the long-term retention lagoon. The percentage of the populations possessing transmissible R factors was constant in the mechanical treatment and shorter-term retention facilities; however, the ability to transmit was lost in 50% of the infective population of the long-term retention facility. A striking contrast was found between the populations of the remote northern Slave River and those of the urbanized Red River. Of the fecal coliforms in the Slave River, 7.1% were multiresistant, and only 0.79% possessed transmissible R factors. The Red River fecal coliform populations were 52.9% multiresistant, and 18.77% of the total population possessed transmissible R factors. The influence of urbanization and the type of sewage treatment have been shown to affect the selection and survival of multiresistant fecal coliforms and R+ fecal coliforms. Determination of other factors influencing the development and the survival of these populations is needed for rational wastewater management and water quality consideration. (Author's abstract)
W84-02054

DEGRADATION AND TOTAL MINERALIZATION OF MONOHALOGENATED BIPHENYLS IN NATURAL SEDIMENT AND MIXED BACTERIAL CULTURE,
Tennessee Univ., Knoxville. Dept. of Microbiology.
H.-L. Kong, and G. S. Sayler.
Applied and Environmental Microbiology, Vol. 46, No. 3, p 666-672, September, 1983. 6 Fig, 3 Tab, 18 Ref. EPA grant R808457010.

Descriptors: *Monohalogenated biphenyls, *Bacteria, *Biodegradation, Degradation products, Mineralization, Polychlorinated biphenyls, River sediments, Water pollution effects, Solar radiation.

Mixed bacterial cultures obtained from polychlorinated biphenyl-contaminated river sediments are capable of degrading monohalogenated biphenyls under simulated natural conditions. Culture conditions include river water as supportive medium and mixed bacterial cultures obtained from river sediments. Degradation occurs when the substrates are supplied as the sole carbon source or when added together with glucose. The degradation rates of 2-, 3-, and 4-chlorobiphenyl, at 30 micro g/ml, were 1.1, 1.6, and 2.0 micro g/ml/day, respectively. Monobrominated biphenyls, including 2-, 3-, and 4-bromobiphenyl, were degraded at rates of 2.3, 4.2, and 1jIicro g/ml/day, respectively. Metabolites, including halogenated benzoates, were detected by high-performance liquid chromatography and mass spectrometry. By using chlorophenyl ring-labeled monochlorobiphenyls as substrates, total mineralization (defined as CO2 production from the chlorophenyl ring) was observed for 4-chlorobiphenyl but not for 2-chlorobiphenyl. Rates of total mineralization of 4-chlorobiphenyl (at 39 to 385 micro g/ml levels) were dependent on substrate concentration, whereas variation of cell number in the range of 105 to 107 cells/ml had no significant effects. Simulated sunlight enhanced the rate of mineralization by ca. 400%. (Author's abstract)
W84-02060

INVESTIGATIONS ON THE DETENTION SPECTRUM OF RIVER IMPOUNDMENTS USING NATURALLY PROVIDED TRACERS (ERMITTLUNG DES VERWEILZEITVERHALTENS EINES FLUBSTAUSEES MITTELS NATURLICHER, SYSTEMEIGENER TRACER),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
R. Klopp, J. Sommer, and K.-H. Kornatzki.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 2, p 61-65, 1983. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Reservoirs, *Detention time, *Mathematical models, Chloride, Tracers, Water quality.

A mathematical model is presented for the determination of the detention characteristics of river impoundments. The time dependent concentration of a naturally available, perseverant substance (chloride) being measured at the inlet and the outlet of an impoundment served as a tracer. Since the addition of a strange tracer substance is not necessary, all possible problems to be considered with such procedures do not occur. The method was successfully applied at the Ruhr impoundment 'Baldeneysee'. The results were most useful for the interpretation of observed water quality proce
(Author's abstract)
W84-02064

NUMERICAL EXAMINATION OF THE E TION OF AQUATIC SEDIMENTS (RECHN ISCHE BEHANDLUNG DER ELUTION V SEDIMENTEN),
Technische Hochschule, Darmstadt (Germ F.R.). Inst. fuer Wasserversorgung, Abwass seitigung und Raumplanung.
For primary bibliographic entry see Field 2K.
W84-02068

APPLICATION OF IR-SPECTROSCOPY THE DEGRADATION OF ORGANIC S STANCES; REPORT III. CATION TENSI (EINSATZ DER IR-SPEKTROSKOPIE BI ABBAU ORGANISCHER STOFFE; III. MIT LUNG: KATIONTENSIDE),
Bundesanstalt fuer Gewaesserkunde, Cob (Germany, F.R.).
For primary bibliographic entry see Field W84-02076

ACCUMULATION OF MERCURY IN F AND MAN FROM RESERVOIRS IN NOR ERN FINLAND,
Helsinki Univ. (Finland). Dept. of Environme Science.
M. Lodenius, A. Seppanen, and M. Herranen.
Water, Air, and Soil Pollution, Vol. 19, p 237- 1983. 2 Fig, 4 Tab, 50 Ref.

Descriptors: *Mercury, *Fish, *Reservoirs, land, Water pollution sources, Human pathol Environmental effects, Lakes, Bioaccumulation

Increased mercury content in fish taken from cently impounded reservoirs in Finland has sti lated an investigation of possible accumulatio mercury. Samples of fish and human hair w analyzed for mercury content. The concentrat of mercury in fish from man-made lakes w higher than in fish from a natural lake. Fish prey, such as burbot and pike, contained m mercury than other species of fish and hig values were recorded in the flesh than in the li In people the highest mercury concentrations w found in hair samples from middle-aged pe eating substantial amounts of fish from reservo The concentrations were high in males than females, probably caused by a higher fish c sumption. The larger amounts of mercury in reservoirs than in natural lakes was caused both construction and water control activities. source of mercury in new impoundments is ap ently the inundated soil but it is not underst how it is introduced to and accumulated in limnetic foodchain. (Baker-IVI)
W84-02118

EXAMINATION OF BIOACCUMULATI AND BIOMAGNIFICATION OF METALS IN PRECAMBRIAN SHIELD LAKE,
Guelph Univ. (Ontario). Dept. of Zoology.
C. D. Wren, H. R. Maccrimmon, and B. R. Loescher.
Water, Air, and Soil Pollution, Vol. 19, p 277-2 1983. 1 Fig, 5 Tab, 43 Ref.

Descriptors: *Metals, *Lakes, *Bioaccumulati *Biological magnification, Sediments, Cla Birds, Mammals, Fish, Mercury, Trace met Trophic level, Tadenac Lake, Ontario.

A comprehensive examination of metal levels made at various trophic levels within an un turbed Precambrian shield lake ecosystem denac Lake, Ontario). Concentrations of 21 na rally occurring elements were measured in se ments, clams, fish, birds and mammals. Eleme included Hg, Cu, Al, Ba, S, Ni, Cd, Ca, Be, Zn, Pb, Mg, Sr, Fe, V, Mo, Mn, Ti, B, and Elevated sediment concentrations of Mn and may be due to the presence of local sources mineralization. Aquatic organisms in contact w sediments were able to accumulate very high lev

ertain metals relative to other species. The
levels measured in benthic organisms may
t natural sediment charactertistics which
d be taken into account when using such
ls as biological indicators of contamination.
e elements studied, only mercury bioaccumu-
in the fish species examined. Mercury accu-
ed in higher trophic levels and displayed
agnification between three mammal species.
eating birds contained high levels of Hg, Cu,
nd Zn and to a lesser extent Al, relative to the
xamined. The observed higher levels of some
metals in birds and mammals relative to fish
represent normal biological retention of cer-
essential elements, rather than contaminant
agnification. (Baker-IVI)
02119

NSPORT OF PHOSPHORUS IN SURFACE OFF AS INFLUENCED BY LIQUID AND D FERTILIZER PHOSPHATE ADDI-
,
ultural Research Service, Durant, OK.
r Quality and Watershed Research Lab.
Sharpley, and J. K. Syers.
r, Air and Soil Pollution, Vol. 19, No. 4, p
26, May 1983. 2 Fig, 1 Tab, 18 Ref.

riptors: *Fertilizers, *Phosphorus, *Agricul-
runoff, Water pollution sources, Water pollu-
ontrol, Particulates, Pastures, Surface runoff,
ultural chemicals, Superphosphate.

effects of superphosphate (50 kg P/ha), ap-
as a liquid or a solid, on transport of dis-
d and particulate P in surface runoff from
ished pasture were evaluated using field plots
atural rainfall. An approximately 3-fold in-
e in the transport of both dissolved inorganic
particulate P in surface runoff was measured
weeks following fertilizer application in the
form (2.9 and 2.9% of the applied fertilizer P,
ctively) compared to the liquid application
nd 1.1% of the applied fertilizer P, respec-
). The application of solid fertilizer P has a
sustained effect on the concentration of both
ved and particulate P in surface runoff. The
ntration of particulate P had not returned to
refertilizer levels some 16 weeks after the
ation of solid P. Although the application of
fertilizer P reduced losses of P in surface
f from pasture compared to a solid applica-
he agronomic effectiveness of the two forms
be considered. Since solid fertilizer is more
ive on pasture than liquid fertilizer (on an
cost basis), the use of liquid fertilizer may
e an economic method of reducing P trans-
n runoff from agricultural land which has a
P-loading potential. (Moore-IVI)
02121

RAIN DEPOSITION PATTERNS IN THE TINENTAL UNITED STATES,
General, Inc., McLean, VA.
niewski, and E. L. Keitz.
, Air and Soil Pollution, Vol. 19, No. 4, p
39, May 1983. 3 Fig, 1 Tab, 28 Ref. EPA
act 68-01-5051.

riptors: *Acid rain, *Spatial distribution, Pre-
tion, Hydrogen ion concentration, Maps,
la, United States.

of both pH and H(+) deposition in precipita-
have been developed for the continental
d States by analyzing laboratory pH data
nine precipitation chemistry networks and
ingle stations spread across the continental
d States and southern Canada during the late
. Average laboratory pH values were ob-
or calculated for approximately 100 stations,
sopleths of weighted mean pH and mean
l H(+) deposition in precipitation were
. In spite of a wide variety of collection
ds and sampling intervals, there is remarka-
niformity in the average pH among the vari-
ations. Precipitation remains most acidic in
art of the northeastern section of the United
. The next highest level of precipitation acid-
curs in the surrounding area, which includes
Ohio Valley and southern Ontario regions.
Evidence of precipitation acidity is now appearing in Florida, the Colorado Rockies and in population canters along the west coast, where pH values at or below 5 are now recorded. Hugh data gaps are apparent in the western portion of the country. Even though most western areas are not experiencing acidities at this time, the need for additional monitoring is important due to projected western energy development. (Moore-IVI)
W84-02122

5C. Effects Of Pollution

TOXICITY OF SELECTED PRIORITY POLLUTANTS TO VARIOUS AQUATIC ORGANISMS,
Environmental Research Lab.-Duluth, MN.
G. W. Holcombe, G. L. Phipps, and J. T. Fiandt.
Ecotoxicology and Environmental Safety, Vol. 7, No. 4, p 400-409, August, 1983. 4 Tab, 18 Ref.

Descriptors: *Toxicity, *Organic compounds, *Aquatic populations, Enviromental effects, Water pollution effects, Acenaphthene, Arsenic trioxide, Cadmium chloride, Mercury chloride, Silver nitrate, Chlordane, Endosulfan, Heptachlor, Pesticides, Fish.

Toxicity tests were conducted with selected compounds listed by the United States Environmental Protection Agency as priority pollutants. Acute toxicity information was determined for acenaphthene, arsenic trioxide, cadmium chloride, mercury (II) chloride, silver nitrate, chlordane, endosulfan, and heptachlor. Acute tests were conducted using one or more of the following species: fathead minnows (Pimephales promelas), channel catfish (Ictalurus punctatus), rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), brook trout (Salvelinus fontinalis), bluegills (Lepomis macrochirus), snails (Aplexa hypnorum), or chironomids (Tanytarsus dissimilis). Acute values from these tests ranged from a silver nitrate 96-hr median of 6.7 micrograms/liter for fathead minnows to an arsenic trioxide 48-hr lethal dose of 97,000 micrograms/liter for chironomids. In addition to acute tests, a fathead minnow embryo-larval exposure was conducted with silver nitrate to estimate chronic toxicity. The estimated maximum acceptable toxicant concentration for silver nitrate, based on fathead minnow survival, lies between 0.37 and 0.65 micrograms/liter. (Author's abstract).
W84-01824

HISTOLOGICAL OBSERVATIONS IN GILLS OF THE TELEOST SAROTHERODON MOSSAMBICUS WITH REFERENCE TO MERCURY TOXICITY,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
K. A. Naidu, K. A. Naidu, and R. Ramamurthi.
Ecotoxicology and Environmental Safety, Vol. 7, No. 5, p 455-462, October, 1983. 12 Fig, 9 Ref.

Descriptors: *Mercury, *Toxicity, Histology, Pesticides, Mercury chloride, Industrial wastes, Water pollution effects, Environmental effects.

Histological changes in the gills of Sarotherodon mossambicus exposed to lethal and sublethal concentrations of mercuric chloride were recorded. The characteristics of the test medium (tap water) were: pH 7.0-7.3; alkalinity 9.7 ppm of CaCO3; dissolved oxygen 5.3-6.2 mg/liter; hardness 35 ppm of CaCO3; and temperature 28-32 degrees C. The first group was exposed to 1.5 ppm of mercuric chloride, while the second, third, and fourth groups were exposed to 0.1 ppm of mercuric chloride for 1, 15, and 30 days, respectively. Gross structure of gill filaments appeared normal. Microscopic changes were noted in secondary gill lamellae and interlamellar cells of exposed fish. In the lethal exposure group the secondary gill lamellae were enlarged into bulb-like structures. These bulgings were notes at distal and basal portions of the lamellae. Some of the lamellae were collapsed. Necrosis and desquamation of the lamellae were also noted. In sublethal exposure after one day, in addition to bulgings at the tips of the lamellae, there were hypertrophy and hyperplasia of lamellar and interlamellar cells. In 15-day exposed fish, separation of the epithelial layer of gill lamellae from pillar cells was the prominent feature. Blood spaces between pillar cells of the lamellae were empty. Such damage will probably affect the respiratory function of the gill by reducing respiratory surface area. (Baker-IVI)
W84-01825

BRACKISH-WATER AQUACULTURE IN PYRITE-BEARING TROPICAL SOILS,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2K.
W84-01834

RESTORATION OF NORWEGIAN LAKES BY REDUCTION IN SULPHUR DEPOSITION,
Norsk Inst. for Vannforskning, Oslo.
R. F. Wright, and A. Henriksen.
Nature, Vol. 305, No. 5933, p 422-424, September, 1983. 3 Fig, 13 Ref.

Descriptors: *Acid rain, *Fish Lakes, Acidity, Sulfur, Water pollution effects, Norway.

Acid precipitation, causing the acidification of freshwaters and hence damage to fisheries, affects more than 33,000 sq km of southern Norway. As a first step in dealing with the acidification problem, Norway, Sweden and Finland have proposed that emissions of sulfur in Europe be reduced by 30% by 1993. Using data from a 1974-75 survey of major-ion chemistry and fish populations in 683 lakes in southern Norway, a 30% reduction in sulfur deposition will restore chemical conditions such that 22% of the lakes now experiencing fisheries problems should be able to support fish. The method of prediction derives from empirical relationships between sulfur deposition, water chemistry and fisheries status for several thousand lakes and rivers in Europe and North America. The method takes into account lake-to-lake differences in sensitivity, changes in base cation concentrations, and the buffering of dissolved aluminium at pH readings less than 5.4 and of bicarbonate at pH levels greater than 5.4. (Baker-IVI)
W84-01841

OCCURRENCE OF SOME INDICATOR BACTERIA IN THE WATERS OF AL-KHAIR STREAM, AND AL-JAISH CANAL PASSING THROUGH BAGHDAD CITY,
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
S. F. Jazrawi, and M. W. Ishaq.
Journal of Environmental Science and Health, Vol. A18, No. 5, p 673-684, September, 1983. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Bacteria, *Water quality, *Coliforms, Fecal coliforms, Streptococci, Baghdad, Iraq, Domestic waste.

Water samples were collected from twelve stations located in two water sources in Baghdad city. Samples were monitored for total aerobic bacteria, total coliforms, fecal coliforms and fecal streptococci. Samples were collected monthly from December of 1980 to December of 1981. High counts of pollution indicator were observed at all stations studied and were distributed independently of temperature, pH, and chloride concentration of the water samples. Total bacteria numbered from 2000 to 9000/ml in Al-Khair stream water and 2000 to 6000 m/l in the water of Al-Jaish canal. The population of total coliforms in the water of Al-Khair stream varied between 1000 and 4000/100 ml and that of fecal coliforms was between 0 and 3000/100 ml. Whereas the number of total coliforms and fecal coliforms in the water of Al-Jaish canal varied from 1000 to 55000/100 ml and from 0 to 100000/100 ml respectively. Numbers of total and fecal coliforms were highest in December which may be associated with the heavy rainfall which occurred within 24 hrs of sampling. Fecal streptococci were present mainly in lower amounts than the fecal coliforms in water samples. The constant presence of the indicator organisms in the samples

was due to the fact that there is continuous discharge of untreated domestic wastes in these two water sources. No periodic self purification was observed in the waters of these sources. Therefore, these water sources are not suitable for public water supplies, swimming, or recreational purposes. (Baker-IVI)
W84-01859

CONTAMINATION OF A MAJOR WATER SUPPLY BY GULLS (LARUS SP.); A STUDY OF THE PROBLEM AND REMEDIAL ACTION TAKEN,
Strathclyde Regional Council, Glasgow (Scotland). Water Dept.
C. Benton, F. Khan, P. Monaghan, W. N. Richards, and C. B. Shedden.
Water Research, Vol. 17, No. 7, p 789-798, 1983. 5 Fig, 4 Tab, 23 Ref.

Descriptors: *Water pollution sources, *Storage reservoirs, *Gulls, *Coliforms, Bacteria, Water pollution prevention, Salmonella, Water supply, Scotland, Glasgow.

In recent years one of the storage reservoirs supplying Loch Katrine water to Glasgow exhibited a serious deterioration in bacterial quality. This was associated with the winter nocturnal roosting habits of gulls (Larus sp.) on the reservoir. Investigations showed a significant correlation between the number of gulls roosting and the numbers of E. coli present in the water. Salmonellae organisms of identical serotypes were isolated from the gulls, from the untreated water and, on three occasions, from the treated water. Broadcasting species specific distress calls of Larus gulls proved to be an effective measure for discouraging gulls from roosting on the reservoir. The routine use of this bio-acoustic method of gull scaring reduced the bacteria in the water to numbers typical of an upland unpolluted reservoir. (Author's abstract)
W84-01897

EFFECT OF ACIDIFICATION, METALS AND METALLOIDS ON SEDIMENT MICROORGANISMS,
Waterloo Univ. (Ontario). Dept. of Biology.
M. D. Baker, W. E. Inniss, C. I. Mayfield, and P. T. S. Wong.
Water Research, Vol. 17, No. 8, p 925-930, 1983. 4 Fig, 1 Tab, 21 Ref.

Descriptors: *Lake sediments, *Hydrogen ion concentration, *Microorganisms, *Decomposition, *Metals, *Metalloids, Water temperature, Lead, Mercury, Arsenic, Selenium, Toxicity, Bacteria, Ontario, Plastic Lake.

Using sediment from Plastic Lake near Dorset, Ontario, the effects of pH changes, metals and metalloids on sediment microorganisms were studied. The mineralization of C-14 glucose was reduced in sediments of pH 4 and 5 compared to pH 7. A large reduction in glucose mineralization was also observed at low temperature (0 degrees C). The majority of bacterial isolates recovered at incubation temperatures of 0 and 20 degrees C were psychrotrophic and the majority of both populations was resistant to lead and selenium while a smaller proportion was resistant to mercury and arsenic. Many of the bacteria were resistant to more than one of the elements. Lead and mercury were more toxic to bacterial growth at pH 4.5 than at 7.5, while selenium and arsenic were slightly more toxic at the higher pH values. The reduction in microbial activity may explain the observed accumulation of organic matter in some acidic lakes. Another factor in such accumulations may be the increase in metal and metalloid concentrations under low pH conditions. (Moore-IVI)
W84-01904

EFFECT OF AN INDUSTRIAL AMMONIA DISCHARGE ON THE DISSOLVED OXYGEN REGIME OF THE WILLAMETTE RIVER, OREGON,
Oregon State Dept. of Environmental Quality, Portland
D. A. Dunnette, and R. M. Avedovech.
Water Research, Vol. 17, No. 9, p 997-1007, 1983. 5 Fig, 6 Tab, 41 Ref.

Descriptors: *Ammonia, *Nitrification, *Water pollution effects, *Dissolved oxygen, *Willamette River, Oregon, Industrial wastewater, Bacteria, Simulation, Computer models, Nitrates.

An industrial discharge of 7000-10,000 kg/day ammonia nitrogen can exert a very great impact on the oxygen regime of the lower Willamette River, Oregon through the microbially mediated process of nitrification. This conclusion is based upon the following evidence: inorganic nitrogen mass flow data; measured reductions in Willamette River dissolved oxygen during ammonia discharge as compared to non-discharge conditions; the present of nitrifying bacteria in mud and attached to aquatic vegetation and river cobbles; verification of a dissolved oxygen model based upon nitrification as a primary ammonia sink and a dominant deoxygenation process; and N-15 heavy isotope tracer studies indicating significant conversion of ammonia to nitrate. Chemical evidence indicates and a dissolved oxygen computer simulation model verifies that a reduction of approximately 50% in as industrial ammonia discharge of several metric tons per day was the major factor in a dissolved oxygen increase of 15% on the lower Willamette River between 1973 and 1979. A shallow, fast flowing, highly surface active and ammonia enriched reach of the river was identified as a reach of high impact active nitrification. In an actively nitrifying reach of the Willamette River a gradual increase in nitrate nitrogen from 0.2 to 0.4 mg/l was observed in a distance of about 53 km. Based on a flow rate of 184 cu m/s this is equivalent to about 3180 kg of ammonia nitrogen nitrified per day in this reach assuming no additional nitrate sources or sinks. (Moore-IVI)
W84-01906

ASSESSING AQUATIC PRODUCTIVITY IN THE HOUSATONIC RIVER USING THE ALGAL ASSAY: BOTTLE TEST,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
N. M. Ram, and S. Plotkin.
Water Research, Vol. 17, No. 9, p 1095-1106, 1983. 6 Fig, 5 Tab, 32 Ref.

Descriptors: *Eutrophication, *Productivity, *Algae, *Water pollution effects, *Housatonic River, Connecticut, Massachusetts, Phosphorus, Nitrogen, Nutrients, Phosphorus removal, Wastewater treatment, Effluent.

Dense algal growth and large diurnal oxygen variations in both free flowing and impounded reaches of the Housatonic River in Connecticut and Massachusetts prompted a concentrated study to assess the need for a comprehensive basin wide phosphorus abatement program and the contribution of point source discharges to eutrophication of the river. Inorganic nutrient levels and bioassay data indicated a predominance of nitrogen limitation below Pittsfield, MA resulting from discharges of phosphorus-rich, municipal and industrial wastewater into the river. N:P ratios suggested that the nutrient status of the river varied, to some extent, even over as short an interval as 2 months and was probably attributable to flow variations in the river. Algal assays of water samples confirmed the nutrient limitation predicted by N:P ratios in 10 out of 13 cases. Additions of varying percentages of untreated, and alum-treated Pittsfield domestic wastewater treatment plant effluent to Housatonic River water, resulted in a linear increase in algal yield that was within 20% of values predicted by inorganic nutrient content. No significant reduction in algal growth response was observed, however, in the alum-treated sewage since its N:P ratio was not sufficiently shifted to phosphorus limitation after 66% phosphorus removal (Al:P equal to 1.3:1). Phosphorus removal at Best Practicable Technology levels would therefore probably not change the nutrient status of the Pittsfield wastewater to phosphorus limitation. (Author's abstract)
W84-01910

ACUTE TOXICITY OF PICRIC ACID AND P RAMIC ACID TO RAINBOW TROUT SAL GAIRDNERI, AND AMERICAN OYST CRASSOSTREA VIRGINICA,
Johns Hopkins Univ., Shady Side, MD. Aqu Ecology Section.
W. L. Goodfellow, Jr., D. T. Burton, W. C. Graves, L. W. Hall, Jr., and K. R. Cooper.
Water Resources Bulletin, Vol. 19, No. 4, p 6 648, August, 1983. 2 Fig, 4 Tab, 38 Ref. Ar grant ARMY M1PR 2506.

Descriptors: *Picric acid, *Picramic acid, *Tox ty, *Trout, *Oysters, Estuarine environment, S ment contamination, Water pollution effects, trophenols, Adsorption.

Picric acid (2,4,6-trinitrophenol) and picramic a (2-amino-4,6-dinitrophenol) are potential wa pollutents due to a variety of industrial and mu tion uses. The possible impacts of picric and p ramic acid to two recreationally and commercia important species, rainbow trout, Salmo gairdn and American oysters, Crassostra virginica, w evaluated. Picramic acid was more toxic th picric acid to both species tested. The 96-h LC for picric and picramic acids for rainbow tr were 109.6 and 46.2 mg/l, respectively. The 14 LC50s for picric and picramic acid for Ameri oysters were 254.9 and 69.8 mg/l, respective Sublethal no growth EC50s and shell deposit EC50s for oysters showed that both compou caused adverse effects at much lower concent tions than indicated by the LC50s. For examp the 144-h shell deposition EC50s were 27.9 m for picric acid and 5.6 mg/l for picramic ac Sediment adsorption studies in estuarine water dicated that both compounds are not readily sorbed which suggests that sediment would play a major role as a sink in contaminated s tems. Oysters, which filter large quantities of p ticulate matter, would more likely be affected picric and picramic acids in the water column th by exposure to contaminated sediment. (Autho abstract)
W84-01951

ONONDAGA LAKE AND DISSOLVE OXYGEN IN SENECA RIVER,
Upstate Freshwater Inst., Syracuse, NY.
S. W. Effler, P. Jaran, and C. F. Carter.
Journal of Environmental Engineering, Vol. 1 No. 4, p 945-951, August, 1983. 1 Fig, 1 Tab, Ref.

Descriptors: *Dissolved oxygen, *Lakes, Lake O ondaga, Seneca River, New York, Rivers, Phy plankton, Water pollution effects, Stratificati

The Seneca River is part of the Three Riv system, which drains more than 5,000 sq miles Central New York to Lake Ontario. There a indications that the source of ionic pollution to t lake, and the chemically-based stratification in t river, may be eliminated in the future. An evalu tion is presented, conducted by model simulati of the impacts the removal of chemical stratifi tion and the range of behavior of released la phytoplankton would have on the dissolv oxygen resources of the river, under critical flo temperature, and loading conditions. Simulatio for both stratified and nonstratified conditio were performed. The lack of density stratificati is predicted to result in greater stress on the syste and substantial contravention of river standar There are a number of limitations in this analys prime of which is the lack of unequivocal mod calibration. Further, the model framework may overly simplistic with respect to dimensionali and the omission of dispersive transport. Howeve more complex models have greater input requir ments. (Baker-IVI)
W84-01957

EFFECTS OF CHANGES IN PH ON TRAN PARENCY AND THERMAL REGIMES O LOHI LAKE, NEAR SUDBURY, ONTARIO,
Ontario Ministry of the Environment, Rexdal Limnology and Taxonomy Section.

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primary bibliographic entry see Field 2H.
-01974

UCTURE-TOXICITY RELATIONSHIPS
R THE FATHEAD MINNOW, PIME-
ALES PROMELAS: NARCOTIC INDUSTRI-
CHEMICALS,
ironmental Research Lab.-Duluth, MN.
). Veith, D. J. Call, and L. T. Brooke.
adian Journal of Fisheries and Aquatic Scienc-
Vol. 40, No. 6, p 743-748, June, 1983. 3 Fig, 2
, 18 Ref. EPA cooperative agreement
309234-01.

criptors: *Toxicity, *Fathead minnows, *Or-
c compounds, Industrial chemicals, Narcosis,
ohols, Ketones, Ethers, Alkyl halides, Ben-
s, Partition coefficient, Molecular structure.

cosis is a reversible state of arrested activity of
oplasmic structures caused by a wide variety
rganic chemicals. This nonspecific mode of
c action was found predominant in acute toxici-
tudies of industrial chemicals and fish. This
er presents 96-h LC50 values for 65 industrial
micals including alcohols, ketones, ethers, alkyl
des, and substituted benzenes. The common
le of action permitted the development of a
cture - toxicity relationship as follows: log
50 = -0.94 log P + 0.94 log (0.000068P + 1) -
where P is the n-octanol/water partition coef-
ent. The data show that the toxicity of the
micals to fish is directly comparable with the
city in mammals when expressed as chemical
vity. (Author's abstract)
4-01975

C, MANGANESE, AND STRONTIUM IN
ERCULA AND SCALES OF BROOK TROUT
LVELINUS FONTINALIS) AS INDICATORS
LAKE ACIDIFICATION,
al Univ., Quebec. CENTREAU.
Moreau, C. Barbeau, J. J. Frenette, J. Saint-
ge, and M. Simoneau.
adian Journal of Fisheries and Aquatic Scienc-
Vol. 40, No. 10, p 1685-1691, October, 1983. 1
, 6 Tab, 41 Ref.

scriptors: *Trout, *Water pollution effects,
ke acidification, Fish scales, Fish opercula,
c, Magnesium, Zinc, Manganese, Strontium.

cium, magnesium, zinc, manganese, and stronti-
were analyzed in opercula and scales of 148
ok trout (Salvelinus fontinalis) from three acidi-
and three nonacidified lakes in Laurentian
k north of Quebec. In the acidified lakes, the
ntent in manganese, zinc, and strontium is 1.6,
and 1.2 times higher than in the nonacidified
es, whereas the concentrations in calcium and
gnesium are not significantly different. A dis-
minant analysis correctly classifies more than
% of all specimens. Furthermore, a cluster anal-
s based on zinc and magnesium concentrations
opercula is successful in grouping 73 and 78%,
pectively, of fish from nonacidified and acidified
es. (Author's abstract)
34-01980

N WE SAVE THE CHESAPEAKE BAY,
Joyce.
w Scientist, Vol. 97, No. 1350, p 797-800, 24
rch, 1983. 4 Fig.

scriptors: *Estuaries, *Water pollution effects,
nvironmental effects, *Chesapeake Bay, Nutri-
ts, Nitrogen, Phosphorus, Acid rain, Bays,
quatic life.

efforts to stop the disappearance of anadromous
h, crab, oyster, and plant life in the Chesapeake
y area, a study was undertaken which divided
e Bay into geographical units but kept in mind
e fact that each of these units works with the
hers in the total ecosystem picture. These units
cluded the tidal freshwaters at the heads of any
the dendritic tributaries that feed the bay, and
e turbidity-maximum area where circular cur-
nts raise a curtain of sediments and living things.
uman influence has been cited as the largest of the causes of the bay's ills. The ever increasing supply of nutrients in the estuary is possibly the major cause behind the thickening of the bay's waters. Scores of sewage plants along the Cheasapeake's tributaries are disgorging nitrogen and phosphorus, natural products of biological sewage treatment. Nitrogen comes in large part from the runoff of fertilizers. In the future, however, current findings indicate that atmospheric deposition of nitrogen especially as nitrate, may well overtake deposition from land runoff. (Baker-IVI)
W84-02012

MICROCOSM AND EXPERIMENTAL POND EVALUATION OF MICROBIAL COMMUNITY RESPONSE TO SYNTHETIC OIL CONTAMINATION IN FRESHWATER SEDIMENTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, R. E. Perkins, T. W. Sherrill, B. K. Perkins, and M. C. Reid.
Applied and Environmental Microbiology, Vol. 46, No. 1, p 211-219, July, 1983. 3 Fig, 5 Tab, 17 Ref. OWRT grant 14-34-001-9096.

Descriptors: *Microorganisms, *Oil pollution, *Sediments, Water pollution effects, Synthetic oil, Hydrocarbons, Aromatic compounds, Ecosystems, Mineralization.

A multivariate approach was used to evaluate the significance of synthetic oil-induced perturbations in the functional activity of sediment microbial communities. Total viable cell densities, ATP-biomass, alkaline phosphates and dehydrogenase activity, and mineralization rates of glucose, protein, oleic acid, starch, naphthalene, and phenanthrene were monitored on a periodic basis in microcosms and experimental ponds for 11 months, both before and after exposure to synthetic oil. All variables contribute to significant discrimination between sediment microbial responses in control communities and communities exposed to a gradient of synthetic oil contamination. At high synthetic oil concentrations (4,000 ml/12 cu m), a transient reduction in sediment ATP concentrations and increased rates of oleic acid mineralization were demonstrated within 1 week of exposure. These transient effects were followed within 1 month by a signficant increase in rates of naphthalene and phenanthrene mineralization. After initial construction, both control and synthetic oil-exposed microbial communities demonstrated wide variability in community activity. All experimental microbial communities approached equilibrium and demonstrated good replication. However, synthetic oil perturbation was demonstrated by wide transient variability in community activity. This variability was primarily the result of the stimulation of polyaromatic hydrocarbon mineralization rates. In general, microcosms and pond communities demonstrated sufficient resiliency to recover from the effects of synthetic oil exposure within 3 months, although polyaromatic hydrocarbon mineralization rates remained significant elevated. (Author's abstract)
W84-02053

INVESTIGATIONS ABOUT THE INFLUENCE OF SMALL NTA-CONCENTRATIONS ON THE FLOCCULATION PROCESS (UNTERSUCHUNGEN UBER DEN EINFLUSS KLEINER NTA-KONZENTRATIONEN AUF DEN FLOCKUNGSPROZESS),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W84-02063

PROBLEM OF CLASSIFICATION OF ACIDIFIED WATERCOURSES (ZUR PROBLEMATIK DER GUTEBEURTEILUNG VON SAUREN FLIESSGEWASSERN),
Gesamthochschule Kassel (Germany, F.R.). Fachbereich Biologie Chemie.
U. Matthias.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 3, p 107-110, 1983. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Acid streams, *Species composition, Kaufunger Wald, West Germany, Shrimp, Mayflies, Water pollution effects.

In the Kaufunger Wald Nature Park, situated east of Kassel, (Germany, F.R.) numerous small watercourses were investigated from the chemical/physical and faunistic viewpoints over a period of two years. It was discovered that a large number of the streams were acidified to varying degrees and had a much reduced biocoenosis in comparison with neutral watercourses. This species reduction had no influence on the classification, since all of the watercourses investigated were assigned to Quality Class I or I-II on the Hessian water classification map. In future water classifications, such acidification phenomena should be taken into account, since they result in a serious deterioration of the biocoenosis, as in the case of sewage input. In particular, the absence of acid-sensitive freshwater shrimps (Gammaridae) and mayflies (Ephemeroptera), which normally inhabit every non-polluted low-mountain brook, can provide evidence of possible acidification in weakly buffered waters with a low lime concentration. (Author's abstract)
W84-02069

INFLUENCE OF DISSOLVED OXYGEN LEVELS ON ACUTE TOXICITY OF PHENOLIC COMPOUNDS TO FRESH WATER TELECOST, NOTOPTERUS NOTOPTERUS (PALLAS),
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
S. Gupta, R. C. Dalela, and P. K. Saxena.
Water, Air, and Soil Pollution, Vol. 19, p 223-228, 1983. 3 Tab, 15 Ref.

Descriptors: *Dissolved oxygen, *Toxicity, *Phenols, Organic compounds, Insecticides, Agricultural chemicals, 2,4-Dinitrophenol, Pentachlorophenol, Phenol, Fish, Notopterus.

Specimens of the fresh water fish Notopterus notopterus were exposed to phenol (P), 2,4-dinitrophenol (DNP), and pentachlorophenol (PCP) separately and in three combinations at three dissolved oxygen levels, 5, 6.5, or 7.8 mg/l for 96 hr in order to determine the influence of dissolved oxygen on the toxicity of phenolic compounds individually and in combination. A decrease in dissolved oxygen level from 6.5 mg/l increased the toxicity of P, DNP, PCP, and the three combinations by 88.0, 188.01, 219.0, and 123-610%, respectively. An increase in dissolved oxygen level from 6.5 to 7.8 mg/l decreased their toxicity by 31.0, 31.6, 22.5, and 23-55%, respectively. The increase in toxicity of these chemicals noted at low dissolved oxygen levels may be explained on the basis that at low dissolved oxygen levels fish must pass more water over the gills in order to obtain sufficient quantities of oxygen. As a result the fish absorb more toxicants via gills than they do at higher dissolved oxygen levels. Consistently, this produces lesions in the gills and also interferes with the normal gas exchange process. (Baker-IVI)
W84-02117

MACROBENTHOS OF LAKE NAINI TAL (U.P., INDIA) WITH PARTICULAR REFERENCE TO POLLUTION,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
P. K. Gupta, and M. C. Pant.
Water, Air, and Soil Pollution, Vol. 19, p 397-405, 1983. 6 Fig, 3 Tab, 16 Ref.

Descriptors: *Benthic environment, *Lakes, *Water pollution effects, Lake Naini Tal, India, Water depth, Benthos, Biological communities.

The important attributes of macrobenthic community structure such as species composition and number, population density, biomass, and dominance and diversity indices were measured at different depths and discussed in relation to pollution of Lake Naini Tal (India). The lake is fed by 22 seasonal and 2 perennial open drains carrying large amounts of domestic waste, urban runoff, and silt into the lake, which are main sources of pollution.

A total of 30 species were recorded from the entire lake. The total number of species, taxonomic groups, density, biomass and diversity index declined with depth up to 7 m; thereafter macrobenthos disappeared. Three different zones of pollution in the lake were distinguished: heavily polluted zone below 7 m, moderately polluted zone between 5 and 7 m depths, and pollution influenced zone from 0 to 5 m depths. As the major part of the lake had become afaunal, there is an urgent need to exercise control on the activities which tend to increase pollution. (Baker-IVI)
W84-02123

5D. Waste Treatment Processes

INTEGRATED WASTEWATER MANAGEMENT,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
B. R. Kansakar, and C. Polprasert.
Journal of Environmental Engineering, Vol. 109, No. 3, p 619-630, June, 1983. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Wastewater management, *Sludge management, Goal programming, Network design, Costs, Land use, Environmental effects, Water quality, Computer models, Interceptors, Sludge disposal, Routing.

A multiobjective goal programming method is proposed for use in analyzing problems involving a network flow structure which are commonly found in the wastewater and sludge management systems when cost functions are linear. The goals considered are the minimization of: (1) costs, (2) water quality impact, and (3) land use impact. The model also selects interceptor routes, treatment plants, transport routes and sludge disposal sites, along with flow directions through these facilities under optimal solutions. A hypothetical example problem dealing with regional wastewater management is analyzed to demonstrate the potential usefulness of the method. (Author's abstract)
W84-01771

ANAEROBIC BIOTECHNOLOGY FOR INDUSTRIAL WASTEWATER TREATMENT,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
R. E. Speece.
Environmental Science and Technology, Vol. 17, No. 9, p 416A-427A, 1983. 4 Fig, 4 Tab, 97 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Anaerobic conditions, Bacteria, Methanogens.

The majority of industrial wastewaters that appear to be good candidates for anaerobic treatment now require new phases of inquiry. The basic question centers around the rate at which the wastewater is degradable, and to what degree. The bioconversion of the organic feedstocks in industrial wastewaters to methane is accomplished by a consortium of bacteria comprised of chemoheterotrophic, nonmethanogenic bacteria and methanogenic bacteria. Methanogens are often considered the key class of microorganisms in anaerobic biotechnology. At least three cofactors are apparently unique to methanogens, and recently a newly discovered cofactor, 2-mercaptoethanesulfonic acid, has been found in all methanogens available in pure culture except Methanobacterium ruminantium, which requires it for growth. Since complex wastewaters containing organics have a continuous range of degradation rates, at low loading rates, the rate-controlling step may be acid formation, as is evidenced by low volatile acids concentrations. As the loading rate increases, the methanogenesis stage may gradually become the rate-controlling step, as evidenced by an accumulation of volatile acids. One problem which can be a serious hindrance to the commercialization anaerobic biotechnology lies in the lack of understanding of the trace nutrient requirements of methanogens. The number of substrates that have been proven amenable to anaerobic biotechnology is quite extensive. One major consideration inherent in anaerobic biotechnology is the relatively low synthesis ration of the methanogens. Special attention must be paid to ensure efficient retention of the biomass in the system. (Baker-IVI)
W84-01778

REDUCING WATER DEMAND AND WASTEWATER FLOW,
Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 3D.
W84-01796

OPTIMIZING LARGE-SCALE WATER TREATMENT PLANTS FOR ASBESTOS-FIBER REMOVAL,
Southern California Metropolitan Water District, La Verne. Water Quality Branch.
M. J. McGuire, A. E. Bowers, and D. A. Bowers.
Journal of the American Water Works Association, Vol. 75, No. 7, p 364-370, July, 1983. 19 Fig, 4 Tab, 12 Ref.

Descriptors: *Water treatment, *Filtration, *Asbestos, Turbidity, Drinking water, Colorado River, California.

Standard and optimized treatment were alternated at five filtration plants in southern California that receive low to high concentrations of chrysotile asbestos fibers in their influents. The removals of asbestos fibers and turbidity by these plants are reported. Asbestos fiber concentrations in the five treatment plants influents were different because of the different sources of supply, the presence or absence of source-water reservoirs, and variations in the blends of the Colorado River water and the water in the state project. The ability of each plant to remove asbestos fibers was dependent on the asbestos concentration in the influent and the efficiencies of the individual treatment processes. In two cases (Weymouth and Diemer plants) a high percentage of removal of asbestos fibers did not result in levels as low as those at a plant that was less effective in particle removal. The 0.10 ntu goal for fiber effluent turbidity was not achieved on a consistent basis by all five treatment plants. One particular plant had trouble meeting the goal probably due to a problem with balancing flows and with a lack of continuous effluent turbidity monitoring equipment. Attainment of the 0.10-ntu level did not guarantee a low effluent asbestos concentration. In general, optimized treatment resulted in lower effluent asbestos concentrations than standard treatment. However, many of the effluent asbestos levels determined in this study were much higher than those reported in the literature. It appears that there is little hope of using 0.10 ntu as a surrogate level for asbestos fibers in treated drinking water. (Baker-IVI)
W84-01801

ENVIRONMENTAL STUDIES OF ENTERIC BACTERIA LONGEVITY IN MEMBRANE FILTER CHAMBERS,
National Water Research Inst., Burlington (Ontario). Analytical Methods Div.
B. J. Dutka, and K. K. Kwan.
Journal of the American Water Works Association, Vol. 75, No. 7, p 380-382, July, 1983. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Bacteria, *Seasonal variation, Wastewater treatment, Disinfection, Effluent, Water pollution sources, Escherichia coli, Klebsiella, Salmonella, Streptococcus, Serratia, Survival time, Public health.

Two studies were carried out over several seasons to ascertain the survival of pathogenic, indicator, and tracer bacteria in membrane filter chambers. The chambers were placed in a freshwater bay contaminated with industrial waste and domestic sewage and in a freshwater pond. Escherichia coli, Klebsiella pneumoniae, Salmonella thompson, Streptococcus faecalis, and Serratia marcescens were the bacteria used. The survival times for these bacteria were lengthy (>77 days) under either summer or winter conditions. Thus, the use of seasonal effluent disinfection might eventually result in bacterial contamination of downstream sediments and possibly of waters overlying these sediments. As a result of certain disturbances, these bacteria could be recycled throughout the water column and eventually into man or animals directly or indirectly through potable water supplies. Sewage must be disinfected throughout the year if receiving waters are to have any commercial or recreational value or are to be a safe source of potable water. (Moore-IVI)
W84-01804

ASSESSING THE SUITABILITY OF SOILS WITH MACROPORES FOR SUBSURFACE LIQUID WASTE DISPOSAL,
Stichting voor Bodemkartering, Wageningen (Netherlands).
J. Bouma, C. Belmans, L. W. Dekker, and W. J. M. Jeurissen.
Journal of Environmental Quality, Vol. 12, No. 3, p 305-311, July-September, 1983. 7 Fig, 28 Ref.

Descriptors: *Macropores, *Soil porosity, *Subsurface waste disposal, *Land disposal, Permeability coefficient, Simulation, Computer models, Ponding, Drainage, Soil breakthrough, Soil crust, Soil saturation.

The capacity of soils to accept and purify liquid waste can be manipulated by using different application regimes. The associated transient soil physical conditions, which govern purification processes, were measured experimentally in soil columns and in situ, and were predicted by simulation in three soils of which two had macropores. Measurements of pressure heads, outflow rates, and breakthrough curves were made following intermittent liquid applications of 2 cm/d. Rapid breakthrough and short-circuiting, which were observed in the soils with the macropores, could be reduced by adding a light crust. Predictions involved computer simulation of pressure heads during infiltration and redistribution, and of outflow rates in the columns. Good agreement was found between measured and calculated values, but only when the model for soils with macropores was modified to include a subprogram for macropore flow. Simulation required hydraulic conductivity (K) at and near saturation, which was obtained with a modified crust test procedure. Use of the simulation program allows the prediction of soil physical conditions for a range of application rates in terms of ponding times and drainage rates, which affect purification and clogging. Measurement of breakthrough curves yields travel times as a function of application rates. Optimal application rates can be estimated by considering these two types of data, as is illustrated with an example. This approach is preferred over the current procedure using a single hydraulic parameter. (Author's abstract)
W84-01805

ANAEROBIC TREATMENT OF RAW DOMESTIC SEWAGE AT AMBIENT TEMPERATURES USING A GRANULAR BED UASB REACTOR,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
G. Lettinga, R. Roersma, and P. Grin.
Biotechnology and Bioengineering, Vol. 25, No. 7, p 1701-1723, July, 1983. 5 Fig, 7 Tab, 19 Ref.

Descriptors: *Biological wastewater treatment, *Anaerobic digestion, *Domestic waste, Temperature effects, Sludge, Wastewater treatment, Chemical oxygen demand.

Results obtained in a 120 liter 2 m high upflow anaerobic sludge blanket reactor with raw domestic sewage and using a granular sugar beet waste cultivated seed sludge, reveal the feasibility of this type of anaerobic treatment of domestic sewage. Under dry weather conditions 65-85% COD reduction can be achieved at temperatures in the range of 8-20 degrees C and at hydraulic loads as high as 2 cu m/cu m/day. In the case of heavy rainfall the COD-reduction drops to 50-70% and occasionally, at very low influent COD, even below 50%. The net methane production amounts to 7.1-7.3 cu m/population equivalent/year, and the excess sludge production ranges from 5.0-8.6 kg total solids/population equivalent/year. Anaerobic treatment of raw sewage not only appears to

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attractive proposition for tropic areas but
or moderate climatic areas. Generally the
bic treatment step should be followed by
dequate post-treatment in order to meet the
ions set for discharge of effluents into re-
waters. (Baker-IVI)
1817

ECHNOLOGY IN THE WATER INDUS-

Research Centre, Stevenage (England).
incent.
Services, Vol. 87, No. 1050, p 346-349,
, 1983. 5 Fig, 58 Ref.

ptors: *Biological treatment, *Bacteria, *Ox-
, Wastewater treatment, Organic matter,
tic wastes, Nitrates, Ammonia, Methane,
bic digestion, Aerobic treatment.

nnology is not a new field, having been used
water industry for a number of years in the
ses of activated sludge, biological filtration
aerobic digestion. These processes are cheap
fective and any radically different new proc-
would need to be shown to have major cost
rformance benefits. Biological wastewater
ent processes use naturally occurring proc-
nd employ natural selection of microorga-
arriving with the sewage to achieve the
end. The microorganisms of most impor-
is the bacterium although protozoa play a
ole in clarification of effluent and higher
sms are essential in the ecology of the perco-
filter. The biochemical reactions that the
a carry out include oxidation of organic
to carbon dioxide and water, oxidation of
nia to nitrate, oxidation of nitrite to nitrate,
ion of nitrates to nitrogen, conversion of
c matter to acetic acid, hydrogen and carbon
e, and conversion of acetic acid, hydrogen
rbon dioxide to methane. (Baker-IVI)
1878

TMENT OF LOW STRENGTH DOMES-
ASTEWATER USING THE ANAEROBIC
R,
rd Oil Co. (Ohio), Cleveland.
Kobayashi, M. K. Stenstrom, and R. A.

Research, Vol. 17, No. 8, p 903-909, 1983. 7
Tab, 24 Ref. Univ. of California Appropriate
ology Program grant 78-9-5000.

ptors: *Anaerobic digestion, *Wastewater
ent, *Anaerobic filter, Domestic
vater, Biochemical oxygen demand, Sus-
d solids, Methane, Sulfides, Ammonia.

oratory scale anaerobic filter packed with
tic high surface area trickling filter media
used to treat a low strength domestic
vater averaging 288 mg/l COD. The filter
perated for 60 days after reaching steady-
t 20, 25, 35 C at a loading rate of 0.02 lb
cu ft/day and 24 h hydraulic retention time.
effluent BOD 5 averaged 38 mg/l providing
rage removal rate of 79%, and effluent COD
ed 78 mg/l, corresponding to a 73% remov-
e. Removal efficiencies showed very little
vity to daily fluctuations in influent
vater quality. The filter performance at 25
C was not significantly different, but BOD
SS removal efficiency declined at 20 C. Gas
ction averaged 0.027 cu ft of gas per cu ft of
t wastewater, or 1.875 cu ft of gas per
of influent COD. Gas composition averaged
itrogen, 65% methane, and 5% carbon diox-
mmonia nitrogen and sulfides both increased
treatments. It is concluded that the anaero-
ter is a promising candidate for treatment for
rength wastewaters and that post treatment
lfides and ammonia may be necessary. (Au-
abstract)
01902

IARY TREATMENT OF MUNICIPAL
EWATER BY CYPRESS DOMES,
la Inst. of Tech., Melbourne. Dept. of Envi-
ental Sciences and Engineering.
Dierberg, and P. L. Brezonik.
Water Research, Vol. 17, No. 9, p 1027-1040, September, 1983. 9 Fig, 2 Tab, 27 Ref.

Descriptors: *Cypress domes, *Wastewater treatment, Municipal waste, Nitrogen, Phosphorus, Organic matter, Minerals, Dissolved oxygen, Tertiary wastewater treatment.

The feasibility of using cypress domes as an alternative to physical-chemical methods for tertiary treatment of sewage effluent was demonstrated over a 5 year period. Compared to effluent concentrations, rather small reductions, less than 33%, occurred in the concentrations of nitrogen, phosphorus, BOD, sodium, potassium, chloride, and fluoride in the surface waters of domes receiving treated sewage effluent. Larger reductions or about 50% occurred for calcium, magnesium and sulfate. The conventional treatment plant/oxidation pond itself was effective in reducing levels of BOD and total nitrate, but was ineffective in reducing levels of total phosphate and other minerals. The effectiveness of cypress domes in removing high percentages (greater than 90%) of organic matter, nutrients and minerals is more obvious when concentrations of these substances in the shallow watertable aquifer below the sewage-enriched domes are examined. Concentrations of these parameters in shallow wells in and around the sewage domes were at background levels throughout the study. High chloride values indicated that treated sewage was percolating into the shallow aquifer. Cypress domes and their associated sediments and soils thus can reduce the levels of major water quality parameters to levels comparable to those of conventional tertiary treatment processes. Sediments and vegetation continued to release inorganic ions to the standing water for more than 20 months after the cessation of sewage inputs. Parameters associated with organic matter and with the reducing environment of the sewage-enriched domes displayed a rapid return to background levels. (Baker-IVI)
W84-01907

NITRIFICATION BACK ON TRACK,
GRW Engineers, Lexington, KY.
D. L. Ralston.
Water Engineering and Management, Vol. 130, No. 7, p 29-30, July, 1983. 1 Fig.

Descriptors: *Wastewater treatment, *Nitrification, Sludge disposal, Activated sludge processes.

Continuous and conventional control practices proved to be sufficient to solve nitrification problems at an Ohio wastewater treatment plant. The Fairfield facility is a 6-mgd activated sludge plant with tertiary filtration and anaerobic digestion. Problems centered around the inability of the plant to meet NPDES requirements for ammonia nitrogen during the six summer months that the 2.5 mg/l effluent NH3-N limit is in effect. Problem areas identified included operator knowledge of the nitrification process and operational control techniques for solids handling; recycling of stream management; flow distribution to multi-basin unit processes; application of laboratory data to plant control, regulation of industrial discharges to prevent toxic influent slugs; and inclement weather sludge disposal. Correction of these problems lead to a satisfactory solution. (Baker-IVI)
W84-01913

GROWING A NEW TREATMENT PLANT FROM OLD ROOTS,
Camp, Dresser and McKee, Inc., Atlanta, GA.
C. S. Wilder, and G. Johnson.
Water Engineering and Management, Vol. 130, No. 10, p 28-31, September, 1983. 8 Fig.

Descriptors: *Water treatment facilities, *Water pollution control, Rivers, Georgia, Atlanta, South River, Jackson Lake, South River Basin, River basins.

The upgrading and expansion of the South River Wastewater Treatment Facility is a project which has practically cut a very old plant back to its root to allow a modern facility to arise in efforts to clean up the three rivers that flow through Atlanta. Wastewater discharges from plants in Atlanta and DeKalb County, and the city's three major combined sewer overflows are severely polluting the South River. The South River plant was originally designed in 1936 for an average daily flow of 6 mgd with primary settling, low-rate trickling filters, final settling and effluent chlorination. The multiple-project designed for the Three Rivers area will, when completed, comprise a 37 mgd South River Wastewater Treatment Plant which nitrifies the Intrenchment Creek Plant effluent and provides complete treatment for the previous influent to the Flint River Plant. Modifications are called for to the existing 20 mgd Intrenchment Creek Plant including effluent pumping facilities for discharge to the South River Plant for nitrification. The existing 6-mgd Flint River Plant will be replaced by a pump station for discharging raw wastewater to the South River Plant for treatment. A diversion system will provide a gravity sewer connection to transfer South River Plant effluent to the Chattahoochee River, and two combined sewer overflow facilities will be established with partial treatment to reduce the pollution load in receiving waters in the Three Rivers Program area during certain rainfall conditions. (Baker-IVI)
W84-01917

EXPERTS DISCUSS PRIVATE SECTOR INFILTRATION/INFLOW.
Water Engineering and Management, Vol. 130, No. 10, p 32-42, September, 1983.

Descriptors: *Infiltration, *Water treatment facilities, Wastewater treatment, Management, Decision making.

Most of the national emphasis on infiltration and inflow (I and I) source rehabilitation has been associated with public sector sewers. While this is certainly important, private sector I and I can also be significant. I and I in sanitary sewer systems can affect treatment plant compliance, cause sewer backups and overflows, require excessive expenditures for oversized treatment plants, and bring about no-growth conditions. A panel of four experts has agreed that identification and correction of private sector I and I can be implemented as part of a total sewer rehabilitation program. Special procedures may be needed, consisting primarily of public education and enforcement of municipal utility ordinances. Significant I and I flow reduction may not be possible if the private sector is not addressed. Political and legal issues may have an effect on the ultimate success of the private sector program in various communities. Clarification of existing regulations is required in some places. Managers in charge of other sewer rehabilitation programs across the country should consider the potential impact of all I and I sources on the sewer system - public and private. (Baker-IVI)
W84-01918

TIGHT EFFLUENT SPECS MET WITH DIGITAL CONTROL,
Upper Occoquan Sewage Authority, Centreville, VA.
M. H. Robbins, Jr.
Water Engineering and Management, Vol. 130, No. 11, p 30-36, October, 1983. 2 Fig, 1 Tab.

Descriptors: *Water treatment facilities, *Computers, Regulations, Standards, Wastewater treatment, Occoquan Policy, Virginia.

The Occoquan Policy formulated in Virginia in 1971 called for the construction of an advanced wastewater treatment plant, controlled largely by a computer-aided system. To ensure reliable performance, the facilities incorporate many failsafe features. Both the plant and the collection system are designed so that a single failure of a mechanical or electrical component will not interrupt operations essential in meeting the effluent requirements. The instrumentation and control system has four levels of control: manual, analog hardware, direct digital, and direct digital with analog backup. The instrumentation and control system

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has been an important contributor to the success of the facility. (Baker-IVI)
W84-01919

WASTE WATER COMBUSTION IN A CONFINED SWIRL FLAME,
Duisburg Univ. (Germany, F.R.).
P. Roth, and R. Shamekhi.
Chemical Engineering Science, Vol. 38, No. 7, p 1101-1106, 1983. 8 Fig, 17 Ref.

Descriptors: *Wastewater treatment, *Nitrogen compounds, *Combustion, Industrial wastewater, Thermochemical conversion, Ammonia, Aminoethanol, Caprolactam, Evaporation, Nitrogen oxides, Water reuse.

In some industrial production processes water with dissolved or dispersed organic or inorganic chemical compounds is originated which cannot be biologically treated. One possible way of recycling is high temperature thermochemical conversion in flames. Particular problems are caused by waste water which contains nitrogen compounds. Water with the dissolved N-compounds ammonia, aminoethanol and epsilon-caprolactam (NH3, C2H7NO and C6H11NO) was sprayed into a confined swirl flame operating under various conditions. The model waste water and the atomizing fluid influence the visible flame structure. The rates of mixing and evaporation in the recirculation zone of the combustor flow are high enough to make the droplets quickly vanish. The water dissolved N compounds are assumed to be fully present in the gas phase. The NO yield can be predicted by using Fenimore's empirical correlation function derived from measurements on fuel-N conversion of premixed flames. This fundamental relationship seems to be applicable for very complex combustion situations and in an engineering sense can be used to predict the N conversion factor. (Moore-IVI)
W84-01993

WETLANDS FOR WASTEWATER TREATMENT,
J. Benforado.
EPA Journal, No. 2, p 14-15, October, 1983. 2 Fig.

Descriptors: *Wetlands, *Wastewater treatment, Water plants, Walt Disney World, Florida, San Diego, California.

An aquaculture project funded by the city of San Diego is part of a pilot test advanced treatment facility that treats raw sewage to standards higher than those used for tap water in many cities. Lagoons filled with water hyacinths are used to clean the water. Similar installations ar%;Y at NASA labs at Bay St. Louis, Miss., and at Walt Disney World, Orlando, Florida. In the latter location waste discharge is first given a high degree of secondary treatment and is then treated by one of four different methods. The major portion of effluent is discharged to a cypress swamp, another portion is used for spray irrigation, and overflow from ponds is sent through a cattail marsh. A water hyacinth system has also been constructed for experimental use. In addition to providing waste treatment, managed wetlands can also contribute many other benefits including offering sanctuary to migrating birds. Wetlands purify wastewater through physical entrapment of pollutants in the surface soils and organic litter. (Baker-IVI)
W84-02000

EFFECT OF MEMBRANE MATERIALS AND AVERAGE PORE SIZES ON REVERSE OSMOSIS SEPARATION OF DYES,
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
L. Tinghui, T. Matsuura, and S. Sourirajan.
Industrial and Engineering Chemistry, Product Research and Development, Vol. 22, No. 1, p 77-85, 1983. 3 Fig, 7 Tab, 32 Ref.

Descriptors: *Reverse osmosis, *Dyes, *Membrane processes, Wastewater treatment, Dye industry wastes, Liquid chromatography.

Reverse osmosis separations of 13 dyes were conducted by using cellulose acetate and aromatic polyamidohydrazide membranes of various average pore sized at operating pressures in the range 689 to 1723 kPag. High performance liquid chromatography (HPLC) experiments were also performed with respect to all dyes studied using chromatography columns filled with powders of membrane polymer materials. Interfacial force constants A, B, and D, which are associated with the electrostatic force, van der Waals force, and steric hindrance, respectively, were generated by applying the transport equations to the data from reverse osmosis and HPLC experiments. The interactive forces depend on the chemical structure of the dye molecule and the membrane material, when solvent is fixed as water. They are primarily governed by the net electric charge, polar and nonpolar organic functional groups of dye molecules, and by the acidity-basicity nature of the membrane materials. The force constants enable the prediction of the dye solute separation for a given average pore radius of the membrane. This provides a basis for the choice of membrane materials for use in reverse osmosis applications involving separation of dyes in aqueous solutions, such as the treatment of dye-laden wastewaters. (Moore-IVI)
W84-02009

WASTEWATER TREATMENT - AN AWARD-WINNING SYSTEM,
Amoco Chemicals Corp., Joliet, IL.
G. P. Chodil.
Hydrocarbon Processing, Vol. 62, No. 10, p 61-64, October, 1983. 5 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Industrial wastes, Activated sludge process, Aeration basins, Filtration, Lagoons, Joliet, Illinois.

The Joliet, Illinois facility's wastewater treatment facility is an activated sludge plant consisting of primary basins for equalization of feed surges; aeration basins for biological oxidation of dissolved organics; clarifiers for solids/liquids separation; and polishing facilites including dissolved air flotation, ponds and filters for final treatment of the effluent before discharge to the Des Plaines River. The Amoco plant itself has a production capacity of 500 million pounds per year of raw materials for polyester fiber and film and polystyrene industries. The organic acid content of the wastewaters from the plant results in a total organic carbon concentration of 3,000-4,000 mg/l and a pH of about 4. About 0.5 MMgal per day of these high strength organic acid wastewaters are treated in an activated sludge process before final discharge. (Baker-IVI)
W84-02014

IMPROVE PLANT WATER QUALITY,
Du Pont de Nemours (E.I.) and Co., Beaumont, TX.
W. W. Carden.
Hydrocarbon Processing, Vol. 62, No. 10, p 75-77, October, 1983. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Water treatment, *Industrial water, *Polyelectrolytes, Coagulation, Clarifiers, Sedimentation, Turbines, Fouling, Beaumont, Texas.

Producing high quality water for various in plant uses is of prime concern as long as the processes used are reliable and cost effective. Synthetic organic polyelectrolytes have been used effectively instead of the inorganic coagulants by DuPont's Beaumont (Texas) plant. The plant had used alum/activated silica as coagulant materials for many years. The switch to polyelectrolyte coagulant materials for influent water clarification enabled the plant to meet its more stringent water quality criteria and eliminate the adverse effect of alum treatment. Simple sedimentation has been enhanced through employment of the principles of stabilizing suspensions. Clarification of water is accomplished by two basic mechanisms: electrokinetic coagulation in which the electrostatic charge is neutralized, and orthokinetic coagulation in which the high molecular weight molecules bridge the microflocs into larger, faster settling particles. An adjustment has also been made in the turbine which has reduced significantly the tende cy for solids buildup. The elimination of alu fouling has enables the manufacturing facility avoid production curtailment formerly caused heat exchanger fouling and to eliminate one fiv day annual outage for heat exchanger cleanin (Baker-IVI)
W84-02016

ANAEROBIC WASTEWATER TREATMEN SYSTEM HANDLES HIGH-STRENGTH IN DUSTRIAL WASTE,
Celanese Chemical Co., Bishop, TX. Process Engineering Dept.
L. M. Harvey, and J. C. Rubiano.
Paper Trade Journal, Vol. 167, No. 6, p 28-3 March 30, 1983. 1 Fig, 2 Tab.

Descriptors: *Anaerobic digestion, *Wastewate treatment, Industrial wastewater, Hydrogen io concentration, Heavy metals, Chemical oxyge demand.

The Celrobic Wastewater Treatment System i operation at the Celanese plant at Bishop, Texa was designed to meet projected plant wastewate treatment needs through 1989. The system ha demonstrated a high degree of flexibility for treat ing liquid effluents with widely varying pH o concentrations of COD or heavy metals. The addi tion of the anaerobic reactor upstream of the plant's existing activated sludge system has made possible the treatment of process effluent streams which could not be treated in conventional aerobic systems. The addition of the Celrobic Wastewater Treatment System has increased not only the capacity but also the reliability of the wastewater treatment system at the plant. Improved reliability and economic advantages of methane gas credits and reduced sludge production have proven the retrofit of the Celrobic System to the existing activated sludge system to be the superior alternative for expanding the wastewater treatment facilities at the Bishop Plant. (Baker-IVI)
W84-02047

PHOSPHORUS AND BACTERIA ELIMINATION IN A SEWAGE TREATMENT PLANT WITH A FOURTH PURIFICATION STAGE (WEITESTGEHENDE PHOSPHOR- UND BAKTERIENENTFERNUNG IN EINER KLARANLAGE MIT IV. REINIGUNGSSTUFE),
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
R. Mosimann, and F. Schanz.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 5, p 161-167, 1983. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Tertiary wastewater treatment, *Phosphorus removal, *Coliforms, *Enteric bacteria, Uster, Switzerland, Storm runoff, Rainfall, Wastewater treatment, Sludge basins.

The degree to which phosphorus is eliminated in a sewage treatment plant with a fourth purification stage and the the extent of retention of fecal bacteria (coliform bacteria and enterococci) by the sewage works are considered. The sewage treatment plant chosen for this study is situated in Uster (canton of Zurich, Switzerland). In dry weather, the plant was able to eliminate 96% of total phosphorus; however only 21% of the measured outflow values lay at or below the prescribed value of 0.2 mg total P/l. During a period of rain, even strongly increased amounts of solid waste, such as are swept from roofs, streets and drains, are retained in the fourth purification stage. This contrasts with sewage treatment plants having only two or three purification stages, where considerable amounts of sludge are deposited in the receiving watercourse. As a result of the increased rates of flow and the corresponding short residence time in the sludge basins, a strong increase is observed in the amount of phosphorus in the outflow during the period of rain, in comparison to the conditions existing during dry periods. The fecal bacteria were found to be 92% retained by the fourth stage alone. The final concentration of fecal bacteria in the purified wastewater amounts to only about

of that in the raw sewage entering the plant.
or's abstract)
02075

ICATION OF IR-SPECTROSCOPY IN
DEGRADATION OF ORGANIC SUB-
CES; REPORT III. CATION TENSIDES
ATZ DER IR-SPEKTROSKOPIE BEIM
U ORGANISCHER STOFFE; III. MITTEI-
; KATIONTENSIDE),
sanstalt fuer Gewaesserkunde, Coblenz
any, F.R.).
llmann.
hrift fur Wasser und Abwasser Forschung,
16, No. 5, p 174-179, 1983. 14 Fig, 8 Ref.

iptors: *Wash water, *Wastewater treatment,
adation, *Cation tensides, Domestic wastes,
ering, Clay.

n tensides in the form of distearyldimethy-
niumchloride are applied as active compo-
n softening agents in domestic use and indus-
undries. Owing to their great affinity to solid
es, in particular to clay minerals, physical-
cal elimination in addition to biochemical
dation in sewage treatment plants is to be
ed. The model experiment pursues the deg-
on of k-tensides beyond the potential 'elimi-
', analogous to the degradation of a- and n-
es and non-tensides detergent components in
water, and, where possible, assesses and
fies intermediate products of the degradation.
or's abstract)
02076

HESIS OF ION-EXCHANGE MEM-
NES FOR ELECTRODIALYTIC TREAT-
T OF INDUSTRIAL EFFLUENTS,
Inst. of Tech., Bombay. Dept. of Cemistry.
akravorty, R. N. Mukherjee, and S. Basu.
ination, Vol. 46, p 353-360, 1983. 2 Fig, 3
Ref.

iptors: *Desalination, *Ion exchange, *Elec-
lysis, Membrane processes, Water pollution
ol, Reclaimed water, Metal-finishing wastes,
trial wastewater.

ogeneous ion-exchange membranes have
synthesized by grafting styrene on neutral
thylene films, using a high energy cobalt-60
ion source. The cationic and anionic groups
subsequently introduced by sulfonation and
omethylation followed by amination, respec-
. Physical and electrochemical properties of
embranes were found to be suitable for utili-
in electrodialytic treatment of industrial ef-
s. Electrodialysis (ED) was carried out using
esized membranes in a three compartment
ell to study the techno-feasibility of this proc-
r pollution abatement along with reclamation
ater and precious metals. (Author's abstract)
02088

LING STUDIES AND MATHEMATICAL
ELLING OF ULTRAFILTRATION OF
TILE DESIZING EFFLUENTS,
roth Water Co., Tel Aviv (Israel).
Buckley, R. L. C. Flemmer, and G. R.
es.
ination, Vol. 47, p 171-179, 1983. 4 Fig, 6

riptors: *Membrane processes, *Ultrafiltra-
*Textile mill wastes, *Wastewater renovation,
el studies, Mathematical studies, Cost analysis,
le desizing.

permeate flux from a spiral-wrap ultrafiltra-
membrane is a complex function of inlet pres-
reject flowrate, polymer concentration and
e of membrane fouling. A mathematical
el is presented that describes the permeate flux
e and after the onset of gel-polarization. The
f the model in evaluating the effects of mem-
fouling and cleaning strategies on plant per-
ance is discussed with reference to polyvinyl
ol textile size recovery. The two main effects
h determine the permeate flux of a clean mem-
brane are the transmembrane driving force and the formation of a polymer gel-layer adjacent to the membrane. For very dilute solutions the permeate flux increases with the average transmembrane pressure, which is at a maximum when the reject valve is closed and decreases as the reject flowrate increases. For solutions which form gel-layers, the permeate flux is limited because the formation of a gel-layer implies that the process becomes diffusion controlled. An increase in the reject flowrate decreases the thickness of the gel-layer resulting in an increase in flux. The model assumes that for any particular position along a membrane element, conditions will either be those of gel-polarization or such that the eddies in the reject flow will be adequate to scour the surface. From a network analysis, the optimal configuration of membrane elements shows that significant savings in membrane area and pumping costs are achievable. (Baker-IVI)
W84-02106

MEMBRANE FILTRATION FOR THE REUSE OF CITY WASTE WATER,
Danske Sukkerfabrikker, Nakskov. Reverse Osmosis Div.
O. J. Olsen, and U. H. Haagensen.
Desalination, Vol. 47, p 257-265, 1983. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Desalination, *Filtration, *Membranes, Membrane processes, Ultrafiltration, Municipal wastes, Wastewater treatment, Reverse osmosis, Wastewater renovation.

Membrane filtration represents a feasible alternative for recovery and upgrading of municipal wastewater. A secondary municipal effluent from a plant with a combined mechanical-aerated pond treatment was treated by ultrafiltration. The ultrafiltration performed satisfactorily over a testing period of two and a half months. An economic evaluation of the process shows that the operational costs and the capital costs amount to about 0.5 US dollars per cubic meter of filtrate. Reverse osmosis operation showed that a large improvement in capacity could be obtained by pretreatment of the effluent by ultrafiltration compared to untreated effluent. However, it is obvious that ultrafiltration as a pretreatment method generally does not solve the fouling problem found in the reverse osmosis operation. It is anticipated, nevertheless, that wastewater from plants with higher cleaning efficiency will lead to improved reverse osmosis operations. The characterization of secondary effluent is complex and the performance of reverse osmosis will be to a large extent based on a number of unknown factors in connection with chemical composition of the water and efficiency of the sewage treatment plant. (Baker-IVI)
W84-02109

APPLICATION OF MEMBRANE SEPARATION PROCESSES TO THE TREATMENT OF INDUSTRIAL EFFLUENTS FOR WATER REUSE,
Natal Univ., Durban (South Africa). Dept. of Chemical Engineering.
G. R. Groves.
Desalination, Vol. 47, p 277-284, 1983. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Desalination, *Wastewater treatment, *Membrane processes, Reverse osmosis, Water quality control, Waste disposal, Water reuse, Wastewater renovation, Industrial wastewater.

The discharge of industrial effluents into the water environment is being made more difficult through environment pollution regulations passed to preserve water quality. The applicability and scope of membrane technology for treatment of industrial effluents is gaining ground. The membrane separation techniques, and in particular reverse osmosis, have tremendous potential due to their ability to remove organic and/or inorganic compounds in a one-step process at a reasonable cost. The main problem is the susceptibility to fouling by insoluble salts and certain organic compounds. The major considerations for the application of membrane technology to the treatment of industrial effluents are pretreatment, membrane type, module type and configuration, cleaning requirements, rejection performance and economics. When considering the disposal of the final concentrates from membrane treatment plants, reverse osmosis plants may be considered as concentrating devices for the production of concentrates of total solids in the range of 60-100 g/l, depending on the osmotic backpressure and maximum module operating pressure. For most treatment of industrial effluents, the membrane flux rates will be fairly low and hence reverse osmosis plants cannot be designed on an once-through basis. This is overcome by interstage recycling on series-taper plants or by using batch concentration. Cost effectiveness is improved with increasing membrane production volumes and enhanced reliability of membrane treatment plants. (Baker-IVI)
W84-02110

REVERSE OSMOSIS TREATMENT AND REUSE OF TEXTILE DYEHOUSE EFFLUENTS,
Natal Univ., Durban (South Africa). Dept. of Chemical Engineering.
K. Treffrey-Goatle, C. A. Buckley, and G. R. Groves.
Desalination, Vol. 47, p 313-320, 1983. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater removation, *Dye industry wastes, *Reverse osmosis, Membrane processes, Filtration, Water reuse, Color.

A 30 cubic meter/d pilot plant consisting of screening, alum coagulation, microfiltration and reverse osmosis was operated for 2 years on cotton/nylon/polyester dyehouse effluents. The reverse osmosis modules used were the brackish and seawater UOP PA300 type. The pilot plant operated at water recoveries of 85-95% and temperatures of 30-45 degrees C. The microfiltration unit was used to remove suspended solid and colloidal dyestuffs from the effluent prior to the spiral-wrap membranes. The average permeate flux was 15 l/sq m/hour. The average permeate quality was 60 mg/l of total dissolved solids, 15 mg/l of sodium, 11 mg/l of TOC and 21 ADMI color units. The product water was reused routinely for production dyeing. While fairly severe membrane fouling occurs, it has been controlled through regular cleaning of the membranes. (Baker-IVI)
W84-02111

MAKE-UP WATER TREATMENT AT THERMAL POWER PLANTS AND MULTIPLE WASTE WATER RE-USE,
O. I. Martynova, A. I. Abramov, A. S. Sedlov, L. G. Vasina, and I. P. Iljina.
Desalination, Vol. 47, p 321-325, 1983. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Demineralization, *Powerplants, *Wastewater treatment, Water reuse, Ion-exchange, Evaporation, Make-up water, USSR.

Currently, demineralization of make-up water for the compensation of steam and condensate losses at thermal power stations is carried out mainly by ion exchange. Substantial ecological advantages can be achieved through the use of thermal water treatment with evaporators. At some thermal powerplants in the USSR boiling type evaporators are fed with sodium-cation exchange softened water to get demineralized make-up water. Thermal demineralization using sodium cationized water makes it theoretically possible to minimize wastewater salt content, if it is used repeatedly for sodium cationite filters regeneration. (Baker-IVI)
W84-02112

TREATMENT OF PULP/PAPER BLEACH EFFLUENT BY REVERSE OSMOSIS,
Sappi Ltd., Enstra (South Africa). Dept. of Research and Development.
M. J. Simpson, and G. R. Groves.
Desalination, Vol. 47, p 327-333, 1983. 4 Fig, 5 Tab, 6 Ref.

Descriptors: *Reverse osmosis, *Bleaching wastes, Pulp wastes, Industrial waste, Wastewater treatment, Bleaching wastes, Pulp and paper industry, Membrane processes.

The reverse osmosis treatment of bleach effluents from pulp and paper manufacturing is becoming of increasing importance because of environmental considerations. Investigations on the treatment of bleach effluent with three thin-film composite reverse osmosis membranes are presented. Membrane fouling was significant and was only partially controlled by the manufacturers recommended cleaning procedures. The three membranes tested were: Filmtech brackish water FT30 in a 100 mm diameter spiral-wrap module (type BW30-40-14); UOP brackish water PA300 in a 100 mm diameter spiral-wrap module (type 4600PA); and DDS brackish water HR95 in flat-sheet form. Membrane rejections were above 90% for both inorganic and organic components, for a total solids range of 5-30 g/l. While thin-film composite membranes have good rejections of the organic components of bleach effluents, the membrane fluxes are unacceptably low for the direct treatment of the effluent. (Baker-IVI)
W84-02113

STUDIES ON THE APPLICATION OF RO IN TREATMENT OF RAYON PLANT EFFLUENT,
Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
S. Basu, and S. Moulik.
Desalination, Vol. 47, p 335-342, 1983. 5 Fig, 13 Ref.

Descriptors: *Reverse osmosis, *Textiles, Rayon, Industrial wastes, Water reuse, Turbulent flow, Laminar flow, Wastewater treatment, Wastewater renovation, Water pollution control.

Reverse osmosis is evaluated for the treatment of spinning bath and washing effluent stream for water/chemicals reclamation, along with pollution abatement. Initial membrane evaluation was carried out in a reverse osmosis test loop having 1 mm feed channel height and 0.60 sq cm flow cross sectional area with cellulose diacetate membrane, and thin film amide composite membrane (PA-300). Under varying flow rates concentration polarization modulus was pronounced at low concentrations of sodium sulfate solution (2%), while it was lower at higher concentrations (12%). At higher flow rates, however, polarization modulus was more or less constant, varying between 1.075 to 1.10, depending on feed concentrations and type of membrane used. Mass transfer coefficients calculated from experimental results showed good agreement with predicted data. (Baker-IVI)
W84-02114

DESALINATION OF COALMINE DRAINAGE WATER BY REVERSE OSMOSIS,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 3A.
W84-02115

STUDY OF EMULSIFIED LIQUID MEMBRANE TREATMENT OF PHENOLIC WASTE WATER,
Y. C. Chang, and S. P. Li.
Desalination, Vol. 47, p 351-361, 1983. 10 Fig, 2 Tab, 7 Ref.

Descriptors: *Phenols, *Wastewater treatment, *Membrane processes, Liquid membrane extraction, Chemical recovery.

The emulsified liquid membrane extraction technique is a new and effective method for separation of mixtures with applications in the nuclear industry, hydrometallurgy and wastewater treatment. The emulsified liquid membrane is made by forming an emulsion of two immiscible phases and then dispersing the emulsion in a third phase (i.e. continuous phase). Phenolic wastewater was treated containing 300-950 ppm of phenol with aqueous NaOH solution in an oil type liquid membrane. The treatments were performed in a batch permeater and a continuous counter-current extraction column respectively. In a batch operation, under suitable conditions, 98% of the phenol could be removed from phenolic wastewater and the rate of breakage of the emulsion drops was less than 1% per hour. The overall diffusivities of phenol through the liquid membrane are constant. A continuous counter-current liquid membrane extraction column (6.2 cm diameter, 120 cm long) was installed and its efficiency examined. The height of the theoretical stage of the liquid membrane extraction column was about 160-190 cm. If extraction of phenol from a waste water containing 500 ppm phenol was performed in a column with efficiency of one theoretical stage, more than 99% of phenol might be removed by such a liquid membrane process. (Baker-IVI)
W84-02116

5E. Ultimate Disposal Of Wastes

PROTECTING WATER SUPPLY AQUIFERS IN AREAS USING DEEP-WELL WASTEWATER DISPOSAL,
CH2M Hill Southeast, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W84-01790

SEWAGE SLUDGE FOR CULTIVATING FRESHWATER ALGAE AND THE FATE OF HEAVY METALS AT HIGHER TROPHIC ORGANISMS; I. DIFFERENT METHODS OF EXTRACTING SEWAGE SLUDGE ON THE PROPERTIES OF SLUDGE EXTRACTS,
Hong Kong Polytechnic, Kowloon. Dept. of Applied Science.
F. Y. Tam, and M. H. Wong.
Archiv fur Hydrobiologie, Vol. 96, No. 4, p 475-485, April, 1983. 2 Fig, 1 Tab, 38 Ref.

Descriptors: *Sludge disposal, *Heavy metals, *Algal growth, Aquaculture, Recycling, Waste recovery.

The main aim of this project is to (1) recycle sewage sludge into an unconventional protein material through the cultivation of unicellular algae in water extracts of sewage sludge and (2) study the fate of heavy metals at higher trophic organisms by using the waste-grown algae in rearing other aquatic organisms. In the first part of the project, different methods were employed to extract sewage sludge. Autoclaving was the most effective method in recovering essential nutrients as well as heavy metals from sewage sludge, following by shaking; whereas homogenizing was the least effective. The pH value of the extractant was the main factor in determining the content of heavy metals in sludge extracts. The two extreme pH (2 and 12) yielded extracts with higher essential nutrients. The amount of heavy metals released was negatively correlated to the extractant pH. (Author's abstract)
W84-01845

WASTE CONCENTRATION VS EVAPORATION PONDS FOR REVERSE OSMOSIS REJECT WATER - A CASE STUDY,
Water Services of America, Inc., Milwaukee, WI.
G. F. Leitner.
Desalination, Vol. 44, p 31-38, 1983. 2 Fig, 4 Tab, 4 Ref.

Descriptors: *Reverse osmosis, *Evaporation ponds, *Brine disposal, Desalination, Water resources development.

With the almost universal acceptance of the reverse osmosis process for desalination of brackish waters and its resulting widespread use throughout the world, it becomes increasingly important to seek out ways for further cycle improvement. One area for improvement has been the avoidance of possible contamination of groundwaters through lining reject ponds with synthetic rubber or similar material to prevent seepage into the soil. New developments in the distillation field have resulted in reduced energy requirements for concentrating distillation units. These developments make it practical to consider using vapor compression distillation in combination with reverse osmosis plan inland locations where lined ponds are re due to investment limitations. A case study water project is offered to determine if f concentration of the reject water by distil would be a cost effective solution. (Baker W84-02022

5F. Water Treatment and Quality Alteration

REACTION RATES OF POLYNUCLEAR A MATIC HYDROCARBONS WITH OZON WATER,
Institut Rudjer Boskovic, Zagreb (Yugoslavia)
V. Butkovic, L. Klasinc, M. Orhanovic, J. Tu and H. Gusten.
Environmental Science and Technology, Vo No. 9, p 546-548, 1983. 2 Fig, 1 Tab, 17

Descriptors: *Polynuclear aromatic hydrocarb *Ozone, *Rate constants, Ozonation, Py Phenanthrene, Benzo(a)pyrene, Disinfection, inactivation, Water treatment.

The rate constants for the reaction of pyr phenanthrene, and benzo(a)pyrene with ozon water were determined by means of stopped-spectrometry. The second-order rate const amount to about 40,000, 15,000, and 6,000 cu mol/s, respectively, over the pH range 1-7. corresponding half-lives in presence of 0.000 ozone at pH 7 are less than a second, i.e., they 10,000 times shorter than the values for pyrene benzo(a)pyrene that are dissipated widely in literature. Since ozonation used for the bact disinfection and viral inactivation of drin water usually affords ozone contact times of 4 one can expect that within this time and with ozone dosage of about 1 mg/L, all of the poly clear aromatic hydrocarbons will be oxidized c pletely. The rate constants may also be used for prediction of half-lives of polynuclear arom hydrocarbons in the lower atmosphere. (Moo IVI)
W84-01782

FROM DREAM TO REALITY: LAKE MIC GAN WATER FOR FOUR CHICAGO SU URBS,
PRC Consoer Townsend, Inc., Chicago, IL.
J. E. Callan.
Journal of the American Water Works Assoc tion, Vol. 75, No. 6, p 262-265, June, 1983. 1 F

Descriptors: *Water supply development, *Le aspects, *Lake Michigan, Water conveyan Water quality, Water allocation, Illinois.

The Northwest Water Commission was organiz to supply water to four cooperating suburban C cago communities; Arlington Heights, Buff Grove, Palatine, and Wheeling. In the late 195 water levels in the sandstone aquifer tapped by t cities' wells were declining from 3 to 6 m per ye resulting in higher pumping costs, high main nance costs, and declining water quality. It becam apparent that water would have to be obtain from an alternative source. Securing the legal rig to use water from Lake Michigan took 25 yea and involved a US Supreme Court ruling. T system is now under construction and will be operation of 1984. The project consists of 72.4 k of water transmission mains, a 94-ML reinforce concrete reservoir, a 189-ML/d main pumping st tion, and a 283-ML/d booster pumping statio (Moore-IVI)
W84-01786

TETRACHLOROETHYLENE CONTAMINA TION OF GROUNDWATER IN KALAMAZO
Kalamazoo City Dept. of Public Utilities, MI.
B. Minsley.
Journal of the American Water Works Associa tion, Vol. 75, No. 6, p 272-279, June, 1983. 7 Fig, Tab, 6 Ref.

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scriptors: *Groundwater pollution, *Tetrachlor-hylene, *Water pollution sources, *Water pollu- control, Test wells, Purge wells, Water distri-ion, Chlorinated hydrocarbons, Kalamazoo, chigan.

npling of the Kalamazoo, Michigan, water ply showed 10 micrograms/L of tetrachlor-hylene from an unknown source in a portion of city's water distribution system and in one of city's well fields. The contaminated well was nediately removed from service and pumped to te. A land use study, a theoretical piezometric face, and sequential well drilling techniques fa-ated locating the source and determining the ent of the contamination. An abandoned dry aning business was found to be the source of the tamination. Using the two most contaminated duction wells as purge wells has thus far been effective means of protecting the remainder of well field from further increases in tetrachlor-hylene contamination. To reduce the likelihood any other contamination reaching the central l field undetected, the utility has proposed that mplete well monitoring system be built around central well field to serve as an early warning tem. (Moore-IVI)
4-01788

NTAMINATED GROUNDWATER TREAT-ILITY - A CASE STUDY,
vironmental Engineering Consultants, Inc., lwater, OK.
L. Stover, and D. F. Kincannon.
rnal of the American Water Works Associa-n, Vol. 75, No. 6, p 292-298, June, 1983. 5 Fig, Tab, 5 Ref.

scriptors: *Treatability, *Water treatment, roundwater pollution, Heavy metals, Organic npounds, Waste dumps, Aquifer restoration, emical precipitation, Steam stripping, Activated bon, Adsorption, Biological treatment, Physico-emical treatment.

e contamination of groundwater by toxic organ-chemicals is becoming a widespread concern in United States. The once abundant supply of contaminated groundwater has diminished to the gree that treatment of contaminated groundwat- is being required for direct use and for aquifer toration or reclamation. Removal of organic emicals requires treatability studies to determine proper treatment processes and the proper sign of these processes. Treatability studies show t the volatile organics, extractable organics, and rganics (heavy metals) of concern in the con-minated groundwater near a hazardous waste mp site can be treated successfully by two alter-ive processes. One process consists of chemical ecipitation to remove metals, steam stripping, d activated carbon adsorption. The alternative ocess consists of combined physical-chemical d biological treatment. (Moore-IVI)
84-01791

HEMISTRY OF REDUCED SULFUR SPECIES ND THEIR REMOVAL FROM GROUND-ATER SUPPLIES,
rgent and Lundy, Chicago, IL.
A. Dohnalek, and J. A. FitzPatrick.
urnal of the American Water Works Associa-n, Vol. 75, No. 6, p 298-308, June, 1983. 16 Fig, Tab, 50 Ref.

escriptors: *Hydrogen sulfide, *Groundwater llution, *Water treatment, Sulfide removal, rinking water, Ferrous sulfate, Peroxides, Per-anganates, Ferrates, Cost analysis.

ne removal of hydrogen sulfide from groundwat- supplies was investigated by using various cata-sts and oxidants in bench-scale jar tests that mulated assumed actual conditions in a water eatment plant. Variations in aeration rate, chemi-l dosage, recycled solids, pH, and detention time ere also examined. A ferrous sulfate dosage of 9 g/L reduced sulfide concentrations to 0.05 mg/ largely owing to the catalytic effect of Fe(II). eroxide, permanganate, and ferrate also lowered e sulfide concentrations, with more rapid kinetics than Fe(II). An economic analysis showed that Fe(II) is a cost-effective alternative for sulfide removal. The other oxidants may also prove economical under certain conditions. (Author's abstract)
W84-01792

DETERIORATION OF WATER QUALITY IN LARGE DISTRIBUTION RESERVOIRS (OPEN RESERVOIRS).
Journal of the American Water Works Association, Vol. 75, No. 6, June, 1983. 4 Tab, 40 Ref.

Descriptors: *Water quality, *Reservoirs, Water storage, Seattle, Washington, Hackensack, New Jersey, Southern California, Monitoring, Bacteria, Phytoplankton, Turbidity, Algal growth, Temperature effects, Seasonal variations.

The quality of water in open, filtered-water reservoirs of three distribution systems was monitored in order to ascertain the degree to which water quality deteriorates during storage in the reservoirs. Data are presented from monitoring programs conducted in southern California, Seattle, Washington and Hackensack, New Jersey. In California the water quality parameters met the 1977 standards at all times and all locations. Turbidity occasionally increased to levels exceeding 1 tu. Trihalomethane levels varied but were frequently greater than the 100 microgram/liter standard established by the USEPA for drinking water. Substantial bacterial populations existed in the reservoirs. Algal populations grew to nuisance proportions several times during the study. Chemical airborne inputs do not appear to influence reservoir dynamics significantly, but bacteria may enter the reservoirs through airborne transport. Significant detrimental changes were noted in water quality after reservoir storage. While many significant interrelationships were found between the various parameters that were measured, no key parameters were found whose limitation might inhibit deterioration of water quality in the reservoirs. The difference between evaporation loss and precipitation gain in the reservoirs was relatively small. No significant differences in water quality were noted between various sites in the reservoirs. Seattle studies indicated no problems with phytoplankton but bacterial populations did contribute to water quality degradation in varying degrees, and some of the reservoirs clearly demonstrated an inadequate storage capacity. New Jersey studies showed turbidity levels increasing during warm months with algal populations being the main influence. Bacterial populations increased slightly with postchlorination maintaining a quality equivalent to that of water leaving the treatment plant. Nutrients such as nitrite, nitrate, phosphate and dissolved oxygen were not significantly affected by the open reservoirs. Trihalomethane levels varied as a function of the surface water supply. (Baker-IVI)
W84-01793

WASTEWATER REUSE: A RESOURCE OR A NUISANCE,
American Water Works Association Research Foundation, Denver, CO.
J. G. DeBoer.
Journal of the American Water Works Association, Vol. 75, No. 7, p 348-356, July, 1983. 4 Tab, 19 Ref.

Descriptors: *Water reuse, *Potable water, *Water treatment, Water quality, Water conservation, Wastewater renovation, Groundwater recharge, Reclaimed water.

As demand for good quality water increases, some areas in the United States find that traditional finite sources cannot meet all needs. Although many utilities draw potable supplies from water that has previously been used upstream, the direct reuse of treated water for potable supplies is limited by unknowns concerning health effects and by costs. Planned reuse options, however, are feasible water conservation techniques, especially for industrial and agricultural uses. Reclaimed wastewater can also be used to recharge groundwater, thereby augmenting potable supplies. (Author's abstract)
W84-01799

COLIFORM OCCURRENCE AND CHLORINE RESIDUAL IN SMALL WATER DISTRIBUTION SYSTEMS,
Drexel Univ., Philadelphia, PA. Dept. of Biological Sciences.
M. A. Goshko, W. O. Pipes, and R. R. Christian.
Journal of the American Water Works Association, Vol. 75, No. 7, p 371-374, July, 1983. 1 Fig, 5 Tab, 15 Ref. EPA grant R-805637.

Descriptors: *Residual chlorine, *Coliforms, *Water distribution systems, Escherichia coli, Enterobacter, Klebsiella, Chlorination, Disinfection.

Samples were collected from seven small (0.09-11 ML/d) municipal water systems. Statistical analyses showed that for systems in which the free chlorine residuals vary considerably, there is no association between coliform density and a free chlorine residual of <0.2 mg/L. Enterobacter cloacae and Enterobacter agglomerans were found in samples with a free chlorine residual >0.2 mg/L, whereas Escherichia coll was found only in samples without a free chlorine residual. Some other coliforms species were found at the higher chlorine residuals; however, at all but one site they were found in association with Enterobacter. Klebsiella pneumoniae was found at one site with a free residual chlorine of 0.45 mg/l and with no Enterobacter present. If the mechanism of resistance to free chlorine is production of slime layers, Enterobacter and Klebsiella may well be adapted to grow in distribution systems, and other coliforms could be incorporated in the slime layers that they produce. (Moore-IVI)
W84-01802

REMOVING URANIUM BY CURRENT MUNICIPAL WATER TREATMENT PROCESSES,
Oak Ridge National Lab., TN.
S. K. White, and E. A. Bondietti.
Journal of the American Water Works Association, Vol. 75, No. 7, p 374-380, July, 1983. 4 Tab, 25 Ref.

Descriptors: *Water treatment, *Uranium, Drinking water, Lime, Hydrogen ion concentration, Alum, Carbonates, Minerals.

Raw, intermediate-stage, and treated water samples from 20 public water supplies were analyzed for uranium content. The results indicate that current municipal water treatment practices are not effective in handling uranium. Raising the pH to 9.5 or greater (as in lime treatment) will result in uranium loss by precipitation, the amount of loss varying with the sample. Alum may be effective in uranium removal, but dosage will vary according to carbonate concentration and pH. Such experimentation suggests that uranium removal can be accomplished by water treatment processes with modification of pH, chemical dosages, or both; variation in the order in which treatments are carried out; and special attention to coeffects that exist because of the mineral content of the water or combinations of chemicals used in treatment. (Baker-IVI)
W84-01803

PROBLEMS OF SMALL WATER SUPPLIES,
For primary bibliographic entry see Field 4A.
W84-01820

ACTION OF CHLORINE DIOXIDE ON AQUATIC ORGANIC MATERIALS DURING THE DISINFECTION OF DRINKING WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
Ch. Rav-Acha, R. Blits, E. Choshen, A. Serri, and B. Limoni.
Journal of Environmental Science and Health, Vol. A18, No. 5, p 651-671, September, 1983. 6 Fig, 6 Tab, 33 Ref.

Descriptors: *Chlorination, *Drinking water, *Organic matter, Disinfection, Trihalomethanes, Chlorine dioxide.

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Measurements were made of the total organic halogens produced in the National Water Carrier of Israel after disinfection with chlorine dioxide. Compared to chlorine, chlorine dioxide formed only a very small amount of chlororganic compounds. Mixtures of chlorine and chlorine dioxide which have been reported to reduce the concentrations of both the chlorinated organics as well as the chlorite ions produced by chlorine dioxide, were found not to be of significant benefit due to the fact that high bromide concentrations are present in the National Water Carrier. Thus high ratios of chlorine dioxide to chlorine are needed to reach a significant reduction in trihalomethane concentration. The amount of trihalomethanes can be satisfactorily reduced, however, when chlorine dioxide is introduced a few hours before chlorine. A comparison between chlorine and chlorine dioxide in regard to reaction with a series of polycyclic aromatic hydrocarbons showed that the chlorine dioxide reactions were more unique. While the highly carcinogenic compounds such as benz(a)pyrene and 1,2-benzanthracene react with chlorine dioxide much more rapidly than with chlorine, other hydrocarbons, such as naphthalene and fluoranthene react very little with chlorine dioxide but easily react with chlorine. Findings suggest that in contrast to chlorine which reacts by few possible pathways, chlorine dioxide reacts mainly as a one-electron acceptor. The main organic by-products of chlorine dioxide seem to be aldehydes, ketones and quinones, beside low molecular weight carboxylic acids. Although aldehydes and carboxylic acids are usually regarded as monitoxic materials, the toxicity of quinones and some keto-aldehydes are still largely unknown. (Baker-IVI)
W84-01858

POWER OF GRAVITY CUTS WATER COSTS,
Raymar Engineering, Inc., Walnut Creek, CA.
M. S. Fohrman.
Water Engineering and Management, Vol. 1. 130, No. 7, p 26-28, July, 1983. 4 Fig.

Descriptors: *Water resources development, *Gravity filters, *Water treatment facilities, Lake Hemet, California, Topography.

The Lake Hemet Municipal Water District in California has incorporated unique geographic features at its recently completed Theodore H. Eggen Filtration Plant. This was done by using a gravity flow system as part of the process train. As a result, total power requirements are less than 20 hp. The automated 6 million gallon per day plant required only one hour of supervision each day. Three raw water sources feed the treatment plant. In winter the water comes from the North Fork of the San Jacinto River and from Strawberry Creek. As winter flows diminish, water is diverted from the South Fork of the San Jacinto, which originates from Lake Hemet Dam. All three flows converge into an overflow diversion structure situated more than a mile upstream from the plant site. Filtration is accomplished by four filters in parallel arrangement. To take further advantage of the hilly terrain, a hydroelectric generation facility has been proposed. The system will then produce enough power to accomodate all the electrical needs of the plant with any surplus being sold to the electrical utility. (Baker-IVI)
W84-01912

CONTROL OPTIONS FOR NITRATES AND FLUORIDES,
Black and Veatch, Dallas, TX.
W. J. O'Brien.
Water Engineering and Management, Vol. 130, No. 7, p 36-38, 51, July, 1983. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Nitrates, *Fluorides, *Drinking water, Water quality, Standards, Public health.

Nitrate and fluoride concentrations in drinking water supplies must be controlled for sound public health reasons, primarily for the protection of two population groups - infants, and children up to the age of 14, respectively. Water containing concentrations of nitrate nitrogen greater than 10 mg/l has been known to produce a disorder known as methemoglobinemia in infants less than three months old. Fluoride controls are in force to prevent dental fluorosis, a discoloration or mottling that occurs when teeth are being formed. Strong base anion exchange resins have usually been the preferred method for removing nitrate from water supplies. The major problem is a fouling of the resin when ferrous iron is present in the raw water. Presently it is not economical to use anion exchange resins for removal of fluoride as resins exhibit no selectively for this element. Excess lime softening is frequently used and the amount of fluoride that can be removed by this method is proportional to the quantity of magnesium in the water. (Baker-IVI)
W84-01915

EFFECT OF THE 1981/82 WINTER ON WATER SUPPLIES,
P. S. Turton.
Weather, Vol. 38, No. 10, p 314-318, October, 1983. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Water supply, *Freezing, *Water distribution, Weather, Cold regions, Pipes, Water mains, Leakage.

After the severe winter of 1962/63 the water industry in England and Wales experienced little difficulty during wintertime for the next 15 years. However, 1978/79 and 1981/1982 reminded both the public and the water industry that water pipes are vulnerable to severe frost. Most of the water industry's resulting difficulties in these times were local inconveniences, a heavy burden on staff and an increase in operating costs. Generally the industry coped well in the 1981/82 winter although if the cold had been unbroken the strain would have been considerable. If the recent cold winters herald a longer period of frequent cold winters then the cumulative effect on water mains could be significant and hinder the authorities programs of enhanced leakage control. The mechanisms by which cold weather affects water mains is not well researched or understood as effort is being given toward discovering and repairing leaks. The public must learn to take adequate precautions to prevent burst pipes if they wish to help avoid temporary disruption of the supply of water in winter. (Baker-IVI)
W84-01991

REMOVAL OF BACTERIA FROM WATER BY ADHESION TO CROSS-LINKED POLY(VINYLPYRIDINIUM HALIDE),
Kyoto Inst. of Tech. (Japan). Dept. of Chemistry.
N. Kawabata, T. Hayaski, and T. Matsumoto.
Applied and Environmental Microbiology, Vol. 46, No. 1, p 203-210, July, 1983. 7 Fig, 4 Tab, 10 Ref.

Descriptors: *Disinfection, *Poly(vinylpyridinium halide), Organic carbon, Escherichia coli, Salmonella, Streptococcus, Staphylococcus, Pseudomonas, Adhesion, Bacteria, Water treatment.

Cross-linked poly(vinylpyridinium halide) was found to have a novel and remarkable ability to remove bacteria from water. For example, when 10 g (wet weight) of cross-linked poly(N-benzyl-4-vinylpyridinium bromide) was contacted with 20 ml of suspensions of Escherichia coli (97,000 to 9.7 x 10 to the 7th power /ml), Salmonella typhimurium (8.0 x 10 to the 6th power to 1.1 x 10 to the 7th power /ml), Streptococcus faecalis (5.0 x 10 to the 7th power /ml), Staphylococcus aureus (8.1 x 10 to the 7th power /ml), and Pseudomonas aeruginosa (320,000/ml) under stirring in sterilized physiological saline at 37 degrees C, 99% of the viable cells of these bacteria were removed in 2 to 6 h. When suspensions of these bacteria (100,000 to 10,000,000 cells per ml) were passed through a column (20 mm by 100 cm) of cross-linked poly(N-benzyl-4-vinylpyridinium bromide) at 37 degrees C with a flow rate of 0.8 to 1.4 bed volumes per h, 97 to 100% of the viable cells were eliminated from the suspensions during the treatment. Mechanistic studies demonstrated that cross-linked poly(vinylpyridinium halide) irreversibly captured these bacteria alive during the treatment. That is, total organic carbon was removed during the treatment, and the bacteria which adhered to the resin proliferated on the bacterial medium. The adhesi capacity was estimated to be 10 to the 10th ce per g (dry weight). Total organic carbon was al removed even when the bacteria were killed heat treatment before the column studies. (A thor's abstract)
W84-02052

INACTIVATION OF HEPATITIS A VIRU AND INDICATOR ORGANISMS IN WATE BY FREE CHLORINE RESIDUALS,
National Inst. for Water Research, Pretoria (Sout Africa).
W. O. K. Grabow, V. Gauss-Muller, O. W. Prozesky, and F. Deinhardt.
Applied and Environmental Microbiology, Vo 46, No. 3, p 619-624, September, 1983. 3 Fig, Tab, 29 Ref.

Descriptors: *Hepatitis A virus, *Chlorinatio *Disinfection, Drinking water, Water treatmen Viruses, Bacteriophage, Bacteria, Indicators, Viru inactivation.

Hepatitis A virus (HAV) and selected indicato organisms were mixed together in chlorine demand-free buffers at pH 6, 8, or 10 and expose to free chlorine residuals, and the survival kinetic of individual organisms were compared. HAV wa enumerated by a most-probable-number dilutio assay, using PLC/PRF/5 liver cells for propaga tion of the virus and radioimmunoassay for it detection. At all pH levels, HAV was more sensi tive than Mycobacterium fortuitum, coliphag V1(representing a type of phage common in som sewage-polluted waters), and poliovirus type 2 Under certain conditions, HAV was more resistan than Escherichia coli, Streptococcus faecalis, coli phage MS2, and reovirus type 3. It was always more resistant than SA-11 rotavirus. Evidence i presented that conditions generally specified fo the chlorine disinfection of drinking-water supplies will also successfully inactivate HAV and that HAV inactivation by free chlorine residuals can reliably be monitored by practical indicator systems consisting of appropriate combinations of suitable indicators such as coliform and acid-fast bacteria, coliphages, the standard plate count, and fecal streptococci. (Author's abstract)
W84-02059

METHODS AND RESULTS OBTAINED FROM THE TOXICOLOGICAL AND ECOLOGICAL TESTS OF WATER TREATMENT CHEMICALS (METHODEN UND ERGEBNISSE BEI DER TOXIKOLOGISCHEN UND OKOLOGISCHEN PRUFUNG VON WASSERBEHANDLUNGS-MITTELN),
Henkel KGaA, Duesseldorf (Germany, F.R.). Toxikologische und Okologische Lab.
W. Kastner, and P. Gode.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 2, p 39-47, 1983. 8 Tab, 32 Ref.

Descriptors: *Water treatment, *Chemical treatment, *Toxicity, *Environmental effects, Water treatment chemicals.

After a description of some of the important toxicological and ecological testing procedures, toxicological and ecological data, available in the literature, provided by the manufacturers or measured in our own laboratories are presented in a tabular fashion for some typical water treatment chemicals and their formulations. In addition, the chemical composition of those substances contained in several selected water treatment products are given, grouped according to their function and combinations as used. The areas of application, dosages, methods of application, as well as pH values and classification based upon regulations governing water treatment materials, are also given in tabular form. Based upon these data, the products and the individual components are toxicologically and ecologically assessed and an estimation as to the toxicological and ecological risks in their use is attempted. (Author's abstract)
W84-02061

STIGATIONS ABOUT THE INFLUENCE MALL NTA-CONCENTRATIONS ON THE CULATION PROCESS (UNTERSUCHUN- UBER DEN EINFLUSS KLEINER NTA- ZENTRATIONEN AUF DEN FLOCK- SPROZESS),
bachtalsperrenverband, Siegburg (Germany,

rnhardt, H. Schell, and M. Berger.
rift fur Wasser und Abwasser Forschung, 16, No. 2, p 55-61, 1983. 11 Fig, 2 Tab, 11

iptors: *Water treatment, *Flocculation, *Ni- iacetate, Iron, Filtration, Detergents, Water ion effects.

on flocculation disturbances by small con- itions of NTA (nitrilotriacetate) were made he flocculation apparatus, developed by the bach Reservoir Association. For floc separa- a filter column filled with sand (particle size .9 mm) and a membrane filter (0.45 micro m) used. A very soft water with the addition of g/l Sicron as turbid material was used. Floc- on followed with 1-6 mg/l Fe(3+) as iron-III de. A NTA content of > or = 0.5 mg/l H3- (> or = 0.2 mg/l C) disturbs the floccula- rocess. With application of membrane filters, ncentrations of > or = 0.05 mg/l arise, flocculation occurs with Fe-salts. The mech- of flocculation disturbances is investigated iscussed on strength of the results of mem- filter filtrations with pore sizes 0.45 micro m .20 micro m and ultra filtration with a separa- imit of the molecular weight of nominally). The removal of turbid material is impaired e same extent by NTA-contents in the water = 0.5 mg/l H3-NTA (> or = 0.2 mg/l C). urbidity of such a water increases in spite of ial iron-III-salt quantities (addition of at least /l Fe(3+)). Relatively small NTA-concentra- such as could arise in water bodies as a quence of a partial substitution for phos- s in detergents, can have a disturbing effect e water treatment. (Moore-IVI)
02063

NNING ELECTRON MICROSCOPY (SEM) MINATION OF MANGANESE DEPOSITS FILTER MATERIALS USED IN DRINKING ER PLANTS (RASTERELEKTRONEN- ROSKOPISCHE (REM) UNTERSUCHUNG MANGANABLAGERUNGEN AUF FIL- MATERIALIEN DER TRINKWASSERAUF- EITUNG),
Univ. (Germany, F.R.). Hygiene Inst.
Tuschewitzki, and W. Dott.
chrift fur Wasser und Abwasser Forschung, 15, No. 4, p 121-125, 1983. 12 fig, 22 Ref.

riptors: *Filters, *Manganese, *Water treat- , Biological treatment, Chemical treatment, ium, Silicon, Chloride, Aluminum, Iron.

ganese deposits on different filter materials investigated by SEM and microanalysis. Typ- structures of the deposits were found on filter rial of filters with biological processes: (1) le- and wart-shaped deposits arranged in s; (2) tapering beadstring-like structures with -like surface running more or less parallel. On rial of filters with chemical processes amor- s deposits without characteristic structures found, e.g. in holes of pumice. The deposits analyzed by microanalysis: manganese ed to be the predominating element. Consider- amounts of calcium were found, whereas sili- chloride, aluminium and iron were deter- d to a lower extent. (Author's abstract)
-02070

. Water Quality Control

STORATION OF AQUIFERS,
sephson.
ironmental Science and Technology, Vol. 17, 8, p 347A-350A, August, 1983. 2 Fig.

criptors: *Aquifer management, *Groundwater ution, Groundwater management, Water resources development, Water treatment, Drinking water, Granular activated carbon.

Once an aquifer becomes contaminated there are three basic courses of action which may be taken: forbid use of the aquifer and obtain alternative supplies; attempt to rehabilitate it; or continue to use the aquifer but treat the water before use. The first step toward groundwater restoration is knowing the extent, thickness, rate of spread, and contents of a contamination plume. Conceivably, the zone of contamination could be both overlain and underlain by clean water. That is why the utmost care must be taken, when wells are screened, to account for the three-dimensional aspect of the plume when a monitoring well network is planned. The monitoring scheme used must consider plume spread in two horizontal and one vertical direction over time. A properly installed well monitoring system must monitor the entire thickness of the aquifer being studied. The cost of such wells could range from $400 to $3000 each. Costs for sample analysis could come to $200-$1500 per sample. Once a contaminated plume is identified and mapped, a treatment scheme is needed. Treatment alternatives are considered and then bench and pilot scale studies are conducted. Granular activated carbon (GAC) is a frequently adopted treatment for contamination episodes involving organic chemicals. In some cases multimedia filtration is carried out before GAC treatment as a precaution. In others, air stripping is used to reduce the amount of volatile organics. Aeration, catalyzed chemical oxidation and GAC adsorption have also been used to remove organic solvents including chloroform, carbon tetrachloride, and other low-molecular weight chlorinated hydrocarbons. Pressurized gas aeration followed by direct incineration is undergoing evaluation in place of air stripping. Microbes and an organics removal approach involving powdered activated carbon are being tested with activated sludge. Both reclamation of contaminated groundwater and aquifer recharge can present technical and legal problems. A major factor of the feasibility of groundwater reclamation is cost. (Baker-IVI)
W84-01775

MOVEMENT OF TYPHOID ORGANISMS IN SATURATED PERMEABLE SOIL,
Washington Univ., Seattle. School of Public Health and Community Medicine.
For primary bibliographic entry see Field 5B.
W84-01787

TETRACHLOROETHYLENE CONTAMINATION OF GROUNDWATER IN KALAMAZOO,
Kalamazoo City Dept. of Public Utilities, MI.
For primary bibliographic entry see Field 5F.
W84-01788

PROTECTING WATER SUPPLY AQUIFERS IN AREAS USING DEEP-WELL WASTEWATER DISPOSAL,
CH2M Hill Southeast, Inc., Gainesville, FL.
J. I. Garcia-Bengochea.
Journal of the American Water Works Association, Vol. 75, No. 6, p 288-291, June, 1983. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Deep-well injection, *Wastewater disposal, *Water pollution prevention, *Disposal wells, Groundwater pollution, Water quality control, Monitoring, Geohydrology, Florida.

The geohydrology of Florida allows deep-well injection of treated wastewater in some areas if care is taken to assure protection of overlying aquifers used for public water supplies. The state is underlain by a series of groundwater-bearing strata separated by thick and practically impervious layers. In the southern part of the peninsula, the deeper strata contain saltwater in highly transmissive zones that are effectively separated from the overlying freshwater strata. This allows for the high-rate injection of pretreated wastewater into the deeper saltwater zones. Precautions must be taken during construction, operation, and ultimate abandonment of the disposal wells to assure containment of injected wastes. When a disposal well is abandoned, complete sealing of the casing from the bottom to the surface is required. Monitoring water quality and potentiometric levels in adjoining aquifers is essential during construction, operation, and ultimate abandonment of the facility. (Moore-IVI)
W84-01790

SODA ASH TREATMENT OF A STRONTIUM-90-CONTAMINATED GROUNDWATER SEEP,
Oak Ridge National Lab., TN. Environmental Sciences Div.
B. P. Spalding, and I. L. Munro.
Journal of Environmental Quality, Vol. 12, No. 3, p 366-373, July-September, 1983. 3 Fig, 3 Tab, 17 Ref. DOE contract W-7405-ENG-26.

Descriptors: *Strontium-90, *Groundwater pollution, *Water pollution control, Radioactive waste disposal, Soda ash, Seep water, Chemical precipitation, Conductivity, Hardness, Oak Ridge National Laboratory.

A Sr-90 contaminated groundwater seep on the perimeter of a low-level radioactive solid waste disposal area at the Oak Ridge National Laboratory (ORNL) was treated by burying 315 kg of soda ash in the groundwater flow path leading to the seep, and placing 45 kg of soda ash on the surface of the seep. The concentration of Sr-90 in the seep water fell from an average of 7000 Bq/L to 900 Bq/L for the 90 d after burial, followed by a period of gradual rise back to pretreatment levels over the next 100 d. The electrical conductivity and pH of the seep water increased following soda ash burial, while water hardness fell. Hardness was highly correlated (r = 0.84) with Sr-90 concentrations over the entire 2-year observation period, indicating the similar behavior of Sr-90 and soluble Ca and Mg. This in situ softening of, and Sr-90 precipitation from, the seep water was achieved by coprecipitation of Sr-90 with Ca(Mg)CO3 until the buried soda ash was depleted by dissolution in the groundwater. The soda ash treatment of groundwater seeps appears to be most practical as an interim technique for those situations requiring an immediate, but temporary, corrective action. During this limited but effective period, more permanent corrective actions could be planned at the source of contamination. The electrical conductivity, pH, and hardness of the larger surface stream, into which this seep discharges, were not affected by the soda ash burial, most likely due to the approximately 2000-fold dilution effected by this stream. (Author's abstract)
W84-01810

HISTORY OF ENVIRONMENTAL WATER QUALITY MANAGEMENT IN SCOTLAND,
Clyde River Purification Board, East Kilbride (Scotland).
D. Hammerton.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 4, p 336-346, August, 1983. 22 Ref.

Descriptors: *Water quality, *Water management, Scotland, Legislation, Regulations, Surface water, Pollution control.

Historically the pollution of the aquatic environment has been as severe in Scotland as anywhere in the U.K. The development of an effective pollution control system has been painfully slow, as in England and Wales, and has resulted in a very different administrative framework. It is remarkable that two distinct methods of managing the water cycle should have been evolved within one small nation but there are sound geographical and political reasons for this and the Scottish system appears well suited to the needs of the country. Changes occurring during 1975 provided a major new impetus for local government and for the river purification boards. The previous 324 sewerage authorities had been replaced by 9 regional councils, which were also the strategic planning authorities, thus greatly simplifying and improving the consultative process. The regional council all have highly qualified headquarters staff and thus are able to provide a management service to ensure

that sewage works function at maximum efficiency. In order for the water authorities to meet the obligations of the Control of Pollution Act 1974, Part II, significant upgrading of their scientific expertise in all aspects of oceanography will be required. (Baker-IVI)
W84-01822

MODELING INLAND WATER QUALITY USING LANDSAT DATA,
Australian National Univ., Canberra. Dept. of Engineering Physics.
D. J. Carpenter, and S. M. Carpenter.
Remote Sensing of Environment, Vol. 13, No. 4, p 345-352, September, 1983. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Model testing, *Water quality, *Lakes, Turbidity, Algal growth, Remote sensing, Satellite technology, Landsat, Australia.

The water quality parameters turbidity and algal pigment concentration of freshwater lakes have been modeled and predicted using Landsat multispectral scanner data as multiple linear predictors. Satellite data for an area in South East Australia from seven occasions during 1978 and 1979 were used along with concurrent ground-based measurements from sampling sites on three lakes covering a wide range of water quality regimes. Date-independent models for turbidity and algal pigment were obtained using the satellite multispectral data and the water quality data from up to 21 sampling sites on one lake on six occasions. The sun elevation at the time of satellite overpass was included in the models to account for differences between dates, and the time of sample collection was included to compensate for diurnal variations in pigment fluorescence. These models were used to successfully predict these water quality parameters for this lake on a new occasion and for the two other lakes on three occasions. (Author's abstract)
W84-01853

BURIED PIPE SYSTEM FOR CONTROLLING EROSION AND SEDIMENT LOSS ON IRRIGATED LAND,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
D. L. Carter, and R. D. Berg.
Soil Science Society of America Journal, Vol. 47, No. 4, p 749-752, July-August, 1983. 2 Fig, 2 Tab, 13 Ref.

Descriptors: *Erosion control, *Sediment control, *Furrow irrigation, Irrigation effects, Sediment erosion, Sedimentation basins, Tailwater, Agricultural runoff.

A new system comprised of a buried pipe, with riser inlets from the surface at intervals, along the lower end of furrow-irrigated fields was designed, installed, and evaluated on 21 fields to determine its effectiveness as an erosion and sediment loss control system for irrigated land. The system utilizes small sediment collection ponds with the riser inlets from the buried pipe serving as overflow outlets for the ponds. This system corrects convex-shaped field ends caused by erosion and solves an energy related erosion problem common on furrow-irrigated land. During the first season, these system removed from 80 to 95% of the sediment from runoff water and collected from 4.1 to 40.5 Mg/ha from 12 fields on irrigated land where detailed data were collected. All systems performed without problems and all convex end problems except one were corrected the first season. After the convex ends are corrected, the system continues to reduce sediment loss. This new system eliminates the tailwater ditch, puts more land into crop production, reduces weed problems, and prevents the usual problems associated with a wet tailwater ditch. The buried pipe erosion and sediment loss control system is a major advance in the control of erosion and sediment loss on irrigated land. (Author's abstract)
W84-01866

CONTAMINATION OF A MAJOR WATER SUPPLY BY GULLS (LARUS SP.); A STUDY OF THE PROBLEM AND REMEDIAL ACTION TAKEN,
Strathclyde Regional Council, Glasgow (Scotland). Water Dept.
For primary bibliographic entry see Field 5C.
W84-01897

COMPUTATION AND REPORTING OF DISSOLVED GAS LEVELS,
California Univ., Davis. Dept. of Civil Engineering.
J. E. Colt.
Water Research, Vol. 17, No. 8, p 841-849, August, 1983. 4 Tab, 33 Ref.

Descriptors: *Dissolved oxygen, *Water quality, *Dissolved gases, Seawater, Temperature effects, Salinity, Nitrogen, Argon, Water vapor.

Provisional standards are proposed for the computation and reporting of dissolved gas levels in freshwater and seawater. Total gas pressure should be reported in terms of excess pressure, while component gases such as nitrogen, argon, oxygen and water vapor should be reported in terms of partial or excess pressure. Barometric pressure, dissolved oxygen, water temperature and salinity must also be reported. Recent work in hyperbaric physiology has shown that the initial bubble formation depends on excess pressure and therefore excess pressure is the best predictor of the danger from supersaturation. The concentration of component gases should be expressed as partial pressure in mm Hg rather than percent saturation. Recommended formulae for the computation of gas saturation levels are presented. (Baker-IVI)
W84-01900

REGIONALIZATION OF WATER QUALITY IN THE UPPER FRASER RIVER BASIN, BRITISH COLUMBIA,
Inland Waters Directorate, Vancouver (British Columbia). Water Quality Branch.
P. H. Whitfield.
Water Research, Vol. 17, No. 9, p 1053-1066, September, 1983. 11 Fig, 4 Tab, 19 Ref.

Descriptors: *Water quality, *Cluster analysis, Fraser River, River basins, British Columbia, Water analysis.

Uniformity of water quality in the Upper Fraser River basin was examined using cluster analysis. Substantial variations in water quality were observed within the basin. The differences were largely related to the geology of the watersheds. Differences in water quality were more pronounced among the tributaries than along the mainstream of the Fraser River. The mainstream of the river could be considered to have three distinct reaches where water quality properties were relatively constant. Cluster analysis was a useful technique for establishing similarities and differences for both the tributaries and the mainstrem stations. Good agreement was obtained between the results of cluster analysis and examination of spatial concentration differences. The results of the two methods differed in cases where the rate of change in concentration appeared to be important. The cluster analysis technique used did not consider these changes. Inclusion of derived variables, reflecting the rate of change among sequential stations could improve the discrimination of this technique. The assignment of uniform water quality objectives or stream standards would not be practical due to the substantial differences in water quality observed between adjacent groups of stations. (Baker-IVI)
W84-01908

COST-EFFECTIVE REGULATORY OPTIONS FOR WATER QUALITY LIMITED STREAMS,
Wisconsin Univ.-Madison. Dept. of Economics.
M. H. David, and E. L. David.
Water Resources Bulletin, Vol. 19, No. 3, p 421-428, June, 1983. 2 Fig, 2 Tab, 7 Ref. Dept. of Commerce grant NA800AA-D-0086.

Descriptors: *Permits, *Water pollution control, *Water quality standards, *Costs, Wisconsin, Regulation, Aeration, Transferable discharge permits, Rolling averages, Variable permits, Flow regulation.

With the pressure from industries and municipa ties to reduce the waste water treatment co associated with the permit limits needed to att the goals of the Clean Water Act, attention h turned ways of introducing flexibility into the re ulations without sacrificing the water quality goa Wisconsin is the first state to have adopted variety of options from which dischargers m choose when meeting their water quality requi ments. These options were developed for the e press purpose of minimizing the costs and maxim ing the flexibility of the point source water quali regulations while ensuring that permitted di charge would not violate the water quality stan ards. Options that the state has made available dischargers include: variable permits; rolling ave ages; transferable discharge permits; instream ae ation; and flow regulation. Variable permits a probably the most cost-saving of the options b cause they reduce the average time period durin which the most stringent limits must be met fro 52 wk/yr to several weeks or months in th summer. Rolling averages adddress the inequity o limiting each discharger on the assumption that a others will be discharging at their maximum pe mitted level. Transferable permits are importan because they allow equity considerations to b separated from efficiency. The option to increas the dissolved oxygen or flow of the river reduc somewhat the costs of abatement. Aeration has th additional advantage that it can be used in eme gencies to maintain standards. A mixture of perm options is likely to be the most cost-effective an satisfactory strategy for meeting water qualit standards. Variable permits, some form of cluste permits or rolling averages, transferable permit and instream aeration appear to be the most impor tant options to use in meeting waste load alloca tions on the major rivers. (Moore-IVI)
W84-01927

SOIL EROSION AWARENESS AND USE OF CONSERVATION TILLAGE FOR WATER QUALITY CONTROL,
Iowa Agricultural and Home Economics Experi ment Station, Ames.
P. F. Korsching, and P. J. Nowak.
Water Resources Bulletin, Vol. 19, No. 3, p 459-462, June, 1983. 4 Tab, 13 Ref.

Descriptors: *Soil erosion, *Farming, *Erosion control, *Attitudes, Behavior, Water pollution control, Conservation tillage, Iowa.

Water pollution through loss of topsoil from farmland continues to be a major problem, despite nearly 50 years of providing farmers technical and financial assistance for soil and water conservation. The technology for controlling erosion and water pollution is available, but farmers have been slow in implementing control practices. Using a random sample of 249 farmers from central Iowa, the relationship is examined between awareness of a soil erosion problem and the use of conservation tillage. Average farm size of the operators in the sample was 470 acres, and row crops, corn and soybeans, were the predominant crops. There was a high level of awareness of the need for erosion control, but a rather low level of awareness of the problems of soil erosion and water quality. Approximately 96% of the operators considered the Midwest and Iowa to have a medium or serious soil erosion problem, whereas only about 72% and 54%, respectively, saw a medium or serious problem in their own community or on their own farm. There is a strong relationship between the use of conservation tillage and perceived severity of erosion on the farm. Awareness of a soil erosion problem affects the use of conservation tillage, and awareness can be enhanced by experimental educational strategies such as the development and implementation of a soil and water conservation plan. (Moore-IVI)
W84-01931

TREND ASSESSMENT OF WATER QUALITY TIME SERIES,
University of Western Ontario, London. Dept. of Statistical and Actuarial Sciences.
A. I. McLeod, K. W. Hipel, and F. Comancho.

LIBRARY U. OF I. URBANA-CHAMPAIGN

Resources Bulletin, Vol. 19, No. 3, p 537-
ugust, 1983. 9 Fig, 1 Tab, 39 Ref.

ptors: *Water quality, *Statistical models,
series analysis, Acid rain, Logging, Envi-
ital effects.

ral methodology is described for identifying
atistically modeling trends which may be
ed in a water quality time series. A range of
exploratory data analysis tools are suggested
covering important patterns and statistical
teristics of the data such as trends caused by
l interventions. To estimate the entries in an
spaced time series when data are available
gular time intervals, a new procedure based
easonal adjustment is described. Interven-
alysis is employed at the confirmatory data
s stage to rigorously model changes in the
evels of a series which are identified using
atory data analysis techniques. Furthermore,
ntion analysis can be utilized for estimating
observations when they are not too numer-
he effects of cutting down a forest upon
s water quality variables and also the conse-
es of acid rain upon the alkalinity in a stream
e illustrative applications which demonstrate
fectiveness of the methodology. (Author's
t)
1937

R QUALITY MANAGEMENT OF
NA DE BAY,
Health Organization, Manila (Philippines).
Lee, and B. L. Adan.
l of Environmental Engineering, Vol. 109,
p 886-899, August, 1983. 1 Tab, 4 Ref.

ptors: *Water quality management, *Plan-
*Laguna de Bay, Philippines, Water re-
s development, Water pollution control, Eu-
c lakes, Saline water intrusion, Water supply,
areas, Water demand.

nprehensive water quality management plan
repared for the Lagunda de Bay Basin locat-
ar Metropolitan Manila, Philippines. The
or this management plan has been created by
nfrontation between resources development
nvironmental conservation and made com-
y the spill-over of Metro-Manila population,
rial and commercial growths and agricultur-
velopment in the watershed of this large
tropical lake. Laguna de Bay is a large
w lake which is currently hypereutrophic. It
brackish part of the year as a result of tidal
ons from Manila Bay up the Pasig River,
introduce not only marine water but also
ion for drainage in the downstream receiving
s. The water of this lake will be needed by
ar 2000 to supply the expanding population
tropolitan Manila, when present sources are
developed and utilized. A water quality man-
nt plan was prepared by Government with
operation of international agencies to protect
atural resources so that the beneficial uses of
ke can be preserved. The initial phases of the
rehensive water quality management plan are
implementation. (Moore-IVI)
01955

ELING GROUND-WATER FLOW AT
E CANAL, NEW YORK,
Trans, Inc., Reston, VA.
rimary bibliographic entry see Field 5B.
01956

) DEPOSITIONS AND THE ENVIRON-
T,
Univ. (England). Dept. of Biology.
Chadwick.
io, Vol. 12, No. 2, p 80-82, 1983. 2 Fig, 50

riptors: *Acid rain, *Environmental effects,
r pollution control, Nitrogen oxides, Sulfur
de, Oxides, Sulfur, Nitrogen.

ifying substances present in the atmosphere of
r enviromental significance are oxides of sulfur and nitrogen. Atmospheric sulfur occurs in compounds in gas, liquid and solid phases. Residence times for atmospheric sulfur dioxide are estimated at 1 to 2 days. Wet deposition of sulfur compounds, mainly in aerosol form as sulfate, occurs by in-cloud and below-cloud scavenging. Control strategies for reducing acidifying substances emitted to the atmospheric will need to concentrate on one or more stages of fuel use: before burning, low N and S fuel; during burning, staged, catalytic or coal-limestone combustion; waste gas venting, flue gas desulfurization and ammonia injection. (Baker-IVI)
W84-01969

HYPOLIMNETIC AERATION OF A NATURALLY EUTROPHIC LAKE: PHYSICAL AND CHEMICAL EFFECTS,
British Columbia Ministry of the Environment, Vancouver. Fisheries Research and Technical Services Section.
K. I. Ashley.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 9, p 1343-1359, September, 1983. 16 Fig, 2 Tab, 52 Ref.

Descriptors: *Aeration, *Hypolimnion, *Eutrophic lakes, Water quality control, Thermal stratification, Turbidity, Nitrification, Oxygenation, Phosphorus, Carbon dioxide, Eutrophication, Fish winterkill, Nutrients.

A small naturally eutrophic lake was divided in half with a plastic curtain, and a hypolimnetic aerator was installed and operated in the experimental half for one year. Hypolimnetic aeration had no effect on thermal stratification during the ice-free season but circulated the entire experimental half under ice cover. Aeration increased hypolimnetic turbidity via reduced detrital sedimentation but did not affect epilimnetic transparency. Hypolimnetic oxygen concentrations were increased as was oxygen consumption as both sediment and water column oxidation of organic material was enhanced. Hypolimnetic ammonia concentrations were reduced and sufficient oxygen was added for nitrification to occur. Internal phosphorous loading and hypolimnetic orthophosphate concentrations were reduced but aerobic P regeneration increased. Aeration vented accumulated CO2 from the hypolimnion and decreased hypolimnion calcium, magnesium, bicarbonate, and orthophosphate content via calcium carbonate phosphate coprecipitation. Management applications of hypolimnetic aeration include reduction of internal nutrient loading for eutrophication control, improvement of water quality for domestic use, and prevention of fish winterkill. (Moore-IVI)
W84-01978

MEET ENVIRONMENTAL NEEDS FOR REFINERY EXPANSIONS,
Bechtel Great Britain Ltd., London (England).
M. W. Askew, S. A. Tapley, and R. A. Killick.
Hydrocarbon Processing, Vol. 62, No. 10, p 65-70, October, 1983. 2 Fig, 2 Tab, 1 Ref.

Descriptors: *Industrial wastes, *Environmental impact statement, Oil, Sulfides, Phenols, Heavy metals, Ammonia, Chlorine, Bioaccumulation.

Unique problems are associated with refinery expansions. Sources of wastes are often uncontrolled and their effects on the environment are seldom known. The environmental impact statement should include present environmental status, target environmental status, type and quantity of prospective emissions, impact of emissions, emission control, control technology, emission and environmental status monitoring, and economics and cost effectiveness. The expansion situation calls for additional items to be considered such as existing environmental impacts and status, source characteristics and quantification of existing emissions, possibilities for the integrated control and management of emissions, existing with new emissions within new pollution control systems, and the impact of environmental standards in determining the scope of an expansion project. In regarding aqueous emission problems, oil is the major concern along with sulfides and sulfur bearing organics, phenols, heavy metals, ammonia, free chlorine, salinity, solids in suspension, temperature, chronic and acute toxicity, and potential bioaccumulation of materials. (Baker-IVI)
W84-02015

BACTERIA AND ACIDIC DRAINAGE FROM COAL REFUSE: INHIBITION BY SODIUM LAURYL SULFATE AND SODIUM BENZOATE,
Ohio State Univ., Columbus. Dept. of Microbiology.
P. R. Dugan, and W. A. Apel.
Applied and Environmental Microbiology, Vol. 46, No. 1, p 279-282, July, 1983. 2 Fig, 15 Ref. OWRT grant B073-Ohio.

Descriptors: *Mine wastes, *Acid mine drainage, *Chemautotrophic bacteria, *Anionic detergents, Sodium lauryl sulfate, Sodium benzoate, Detergents, Water pollution control.

Coal mine drainage represents a major environmental problem in regions where high-sulfur coal is mined and mineral wastes are deposited. The problem results from exposure of pyritic minerals, found in intimate association with coal and other minerals, to the combined effects of atmospheric oxygen, moisture, and acidophilic Thiobacillus bacteria. The application of an aqueous solution of sodium lauryl sulfate and sodium benzoate (at approximately 60 parts of detergent per million parts of refuse by weight) to the surface of high-sulfur coal refuse resulted in the inhibition of iron- and sulfur-oxidizing chemoautotrophic bacteria and in the decrease of acidic drainage from the refuse, suggesting that acid drainage can be abated in the field by inhibiting iron- and sulfur-oxidizing bacteria. (Moore-IVI)
W84-02055

PREDICTING COLIFORM CONCENTRATIONS IN UPLAND IMPOUNDMENTS: DESIGN AND CALIBRATION OF A MULTIVARIATE MODEL,
Saint David's Univ. Coll., Lampeter (Wales).
D. Kay, and A. McDonald.
Applied and Environmental Microbiology, Vol. 46, No. 3, p 611-618, September, 1983. 4 Fig, 6 Tab, 40 Ref.

Descriptors: *Multivariate analysis, *Coliforms, *Reservoirs, *Watershed management, Regression analysis, Escherichia coli, Water quality, Mathematical models, Recreation, Water treatment, Bacteria, Catchment area, Water supply, Thruscross Reservoir, Fewston reservoir, England.

A multiple regression model was designed to predict concentration of Escherichia coli and total coliforms in two upland impoundments, Thruscross and Fewston reservoirs, which supply water to the city of Leeds (England). The multivariate approach has improved predictive capability over previous univariate linear models because it includes predictor variables for the timing and magnitude of hydrological input to the reservoirs and physiochemical parameters of water quality. A calibrated model for any particular site would give the catchment manager an information base by which to limit certain recreational activities during periods or at locations of peak bacterial loading. The multivariate approach would also allow the manager of a treatment plant of limited capacity to predict the period and severity of stress by a mixture of environmental conditions producing high bacterial loadings, and to investigate appropriate countermeasures. Regression analysis can provide a useful management tool in multiple-use catchment areas. (Moore-IVI)
W84-02058

REGULATION OF THE PH VALUE IN AQUACULTURE, TAKING THE NH4(+)/NH3(-) RATIO INTO ACCOUNT, (STEUERUNG DES PH-WERTES IN DER AQUAKULTUR UNTER BERUCKSICHTIGUNG DES NH4(+)/NH3(-)VERHALTNISSES),

Goettingen Univ. (Germany, F.R.). Inst. fuer Agrikulturchemie.
M. G. Eissa.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 5, p 153-156, 1983. 4 Fig, 26 Ref.

Descriptors: *Aquaculture, *Ammonia, *Hydrogen ion concentration, Carbon dioxide, Aeration, Nitrates, Nitrification, Calcium.

In aquaculture, feed remnants and excrement, as well as metabolic products from the fish, cause an intensive development of NH4(+), which is in equilibrium with the toxic NH3, depending on proton concentration and temperature. If the pH of productive water is raised, then there is an increase in the amount of NH3 released, so that the equilibrium shifts in favor of the ammonia. The object of this investigation was to follow the influence of the pH value of water throughout the mineralization process of the feed, by using CO2 gas and by applying montmorillonite covered with H(+) or with Ca(2+); also, to study the effects these measures had on the release of NH3 and on other water parameters. Five test variants were chosen. The lowest release of NH3 was recorded with the application of CO2 gas. The other parameters measured (pH, CSB, Ges-N, NH4(+) and NO3(-)) also produced lower values with this method. The highest concentration of NH3 was found in the varient using ventilation. The exchange of NH4(+)ions for H(+) and Ca(2+) ions had a diminishing effect on the release of NH3. The Ca(2+) montmorillonite clearly had a positive effect on the development of nitrate. This could be due to the adsorption of a pH range which was optimal for nitrification and thus favorable for Ca(2+) supply. (Author's abstract)
W84-02074

TRANSPORT OF PHOSPHORUS IN SURFACE RUNOFF AS INFLUENCED BY LIQUID AND SOLID FERTILIZER PHOSPHATE ADDITION,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W84-02121

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

OPTIMAL DESIGNS OF BRANCHED WATER SUPPLY NETWORKS,
Indian Inst. of Tech., Bombay. Dept. of Civil Engineering.
A. V. Chiplunkar, and P. Khanna.
Journal of Environmental Engineering, Vol. 109, No. 3, p 604-618, June, 1983. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Water supply development, *Decision making, Design criteria, Civil engineering, Water supply, Gravity flow, Mathematical studies.

A rational procedure for the optimization of branched water supply networks is developed in closed form, using the Lagrangian Multiplier Technique. The solutions are workable on calculators and obviate the requirement of computers in optimal design and successive reevaluations. Case studies on complete gravity and direct pumping systems are presented to illustrate the solution procedure. Specific examination is made of a simplified approach developed by Swamee to multibranch systems, considering each branch to be initially independent, thereby requiring one Lagrangian multiplier, while estimating the multiplication factor for that branch and later combining all branches by choosing the maximum multiplication factor for common sections. The design identified through this simplified approach has been compared with the exact design considering all the branches simultaneously, thereby requiring as many Lagrangian multipliers as the branches. Despite a marginal difference in the theoretical optimal diameters by the two approaches, the final design remains unchanged due to the requirement of discrete commercial pipe sizes. A complete algorithm for the estimation of theoretical optimal diameters along with a procedure for rounding off to the commercial sizes to minimize the difference in the design by the two approaches is also presented. (Baker-IVI)
W84-01770

RESOURCE ALLOCATION TO INTERRELATED PROJECTS,
Ben-Gurion Univ. of the Negev, Beersheba (Israel).
A. Mehrez, and Z. Sinuany-Stern.
Water Resources Research, Vol. 19, No. 4, p 876-880, August, 1983. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Decision making, *Model studies, Multiattribute utility function, Water resources development, Project planning.

A multiattribute utility function was used to specify the decision-maker's preferences, along with a zero-one budget model, to solve the problem of selecting among interrelated multiobjective long-range projects. Increasing the number of projects increases the complexity of the problem. The advantages of the model for relatively small problems are demonstrated by a case study dealing with a subset of Israeli water development projects for 1981. The concept of partitioning the utility function into attributes has proven useful for the decision maker, as it allows him to test the contribution of the sets of projects to each attribute separately. The possible negative impact of a project on an attribute is also considered. (Baker-IVI)
W84-01880

MODELING TELLS THE HYDRAULIC STORY,
Miller Engineering, Inc., King of Prussia, PA.
T. C. Miller, Jr.
Water Engineering and Management, Vol. 130, No. 9, p 34-35, August, 1983. 1 Fig.

Descriptors: *Model studies, *Hydraulic equipment, Water distribution, System analysis, Planning, Water management.

Hydraulic modeling can be an invaluable asset for optimizing existing or planned water distribution systems. In an aging water system, the need for hydraulic modeling is most commonly recognized when a major system improvement is being planned to a system that has become too complex to comprehend. In a new water system, the engineer has many improvement options available to him, and can use modeling to overview the scope, timing and cost effectiveness of each. Capital improvement planning is perhaps the most dramatic example of the benefits of hydraulic modeling. Basic steps to be considered prior to developing a hydraulic model include understanding how the system operates, identifying the scope of the questions that will be asked of the model, acquiring adequate source data, combining the acquired source data with the hydraulic modeling program, and identifying how the hydraulic model will be cost-effectively maintained and updated. Several case histories are briefly reviewed to discuss the practical application of hydraulic modeling to existing water systems and new water systems. (Baker-IVI)
W84-01916

PROBLEMS OF WATER RESOURCES PLANNING IN INDIA,
CH2M Hill Southeast, Inc., Gainesville, FL.
U. P. Singh.
Water Resources Bulletin, Vol. 19, No. 4, p 577-580, August, 1983. 5 Ref.

Descriptors: *Water resources development, *Planning, *India, Administration, Political aspects, Legal aspects, Public policy, International law, Feasibliity studies, Water rights, Social aspects.

Water resources planning in India since the First Five-Year Plan (1951-1956) has been a very important part of national development planning. However, records show that the results of such p
ning in the last three decades have fallen sho
expectations because of various complex fac
Most of the limiting factors are administra
political, legal, and philosophical, involving pr
ture comprehensive planning, arbitrary selectio
plan targets, administrative 'red-tape,' ineffec
coordination among water resources related
partments, and water ownership conflicts an
various states and with neighboring count
Other constraints are related to a lack of adeq
dependable data, the inadequacy of project fea
ity studies, and a lack of social and political d
pline necessary for adequate mobilization of fi
cial resources. (Author's abstract)
W84-01942

NATIONAL WATER ASSESSMENT: NEED OR NOT,
Utah Water Research Lab., Logan.
L. D. James, D. T. Larson, and D. H. Hoggan.
Water Resources Bulletin, Vol. 19, No. 4, p 5
603, August, 1983. 1 Tab, 9 Ref.

Descriptors: *National Water Assessment, *W
resources, *Water supply, Hydrologic bud
Drought, Floods, Water pollution, Economic
pects, Political aspects, Social aspects.

The Second National Water Assessment combi
the accumulation of a great mass of informat
with interpretations to identify current and fut
water problems. The mass of information will p
vide an invaluable data base for many years. T
contribution of the interpretations is less clear
Problems were identified from water budgets o
areas about half the size of states rather than
focusing on the local and temporary situati
(drought, flood, or pollution) that make wa
crises. Problems were highlighted without evalu
ing their economic, environmental, and social i
pacts. The need for solutions was implied with
probing the costs or feasibility of possible re
dies. Modifying the assessment process to ov
come these problems will add to the work;
because the primary audience is composed of g
eralists, the change may be more in interpretati
and presentation than in detail. The improved
sessment may be costly, but it will save more th
it costs through reduced planning costs and m
efficient water management. The assessm
should cover the range of water problems, co
pare standardized data, interpret hydrologic eve
in terms of economic consequences and other so
etal goals, project trends over a reasonable pla
ning horizon, and communicate water informati
to the political process. (Moore-IVI)
W84-01945

**DESIRED AND ACHIEVED OUTCOMES I
FEDERAL WATER RESOURCES PLANNIN**
Battelle Human Affairs Research Centers, Seatt
WA.
P. A. Bolton, W. B. Lord, and J. A. Chase.
Water Resources Bulletin, Vol. 19, No. 4, p 65
661, August, 1983. 3 Fig, 2 Tab, 8 Ref. OWR
grant 14-34-0001-8404.

Descriptors: *Planning, *Water resources develo
ment, Social aspects, Evaluation, Decision makin

Local or project level planning occurs within mo
federal water resources programs. Such plannin
involves both federal and local participants, an
commonly involves a range of interest groups. It
necessary to know what goals these participan
believe the planning process ought to achieve i
order to design planning procedures which wi
meet their expectations. Social judgment analys
was used to elicit those goals for respondents wh
had participated in one of five different federa
water resources programs, in one of the five diffe
ent roles. Respondents also evaluated the extent t
which the planning activities in a recent project i
which they had participated had actually attaine
the posited goals. The respondents believed tha
responsiveness to local problems was significantl
more important than resolving conflicts or increas
ing public understanding. A fourth goal, achievin
national objectives, was believed to be less impor

an the other three. No significant differences se goal evaluations were associated with the of program in which the respondents had pated. However, there were significant dif- es associated with the respondent's role in anning process. Respondents' ratings of the veness of actual planning projects varied by rogram and respondent role. (Author's ab-
01952

Evaluation Process

OST FACTO ANALYSIS OF THE RE- AL ECONOMIC IMPACT OF EXPENDI- S FOR RESERVOIR RECREATION,
Agricultural Experiment Station, College n. Dept. of Recreation and Parks.
rimary bibliographic entry see Field 6G.
01829

AGING RIVER ENVIRONMENTS FOR PARTICIPATION MOTIVES OF STREAM ATERS,
esota Univ., St. Paul. Coll. of Forestry.
McDonald, and W. E. Hammitt.
al of Environmental Management, Vol. 16, p 369-377, June, 1983. 3 Fig, 1 Tab, 18 Ref.

iptors: *Recreation, *Motivation, Rivers, participation, Public participation, Floating, g, Behavior.

500 individuals engaged in raft or inner-tube g on three streams were surveyed to ascer- heir motives for engaging in this activity. g the 28 reasons given, the most important centered around social experience. Factor is of their reasons for participation further fied five motives, ranked from most impor- affiliation, experiencing nature, action/excite- skill development and solitude. Based upon findings it is suggested that river manage- might manipulate stream resources and on- pportunities to correspond to floater partici- n motives in the following ways. One obvious would be to provide opportunities for users to ipate as groups. Crowding was not a concern aters and they felt no need to control the er of users on the streams, even though use ubstantial. The fact that experiencing nature n important motive on both urban and rural implies that a remote environment providing de and a dispersed form of recreation is not tial for experiencing nature. The third major cation is the need for management to allow n element of risk and excitement during the e experience, still maintaining safety guide- Stream characteristics that will provide op- nities for running rapids, taking acceptable and developing skills should be identified. r-IVI)
01830

LTICRITERIA ANALYSIS OF WATER AL- ATION IN A RIVER BASIN: THE TCHE- HEFF APPROACH,
eton Univ., NJ. Dept. of Civil Engineering.
primary bibliographic entry see Field 6D.
01879

IANCED ROLE OF WATER CONSERVA- N IN THE COST-BENEFIT ANALYSIS OF ER PROJECTS,
s A and M Univ., College Station. Dept. of cultural Economics.
Griffin, and J. R. Stoll.
r Resources Bulletin, Vol. 19, No. 3, p 447- June, 1983. 5 Tab, 20 Ref.

riptors: *Water conservation, *Cost-benefit ysis, *Planning, Water resources development, r demand, Nonstructural alternatives, Eco- ic evaluation, Water supply.

isions in the rules and procedures for perform- cost-benefit analyses of federal water projects ude a requirement that nonstructural and water conservation measures be incorporated into economic assessments of projects. Project analyses will now proceed as if water supplies were allocated most effectively, that is, to their highest valued uses. A related requirement provides that the net benefits of any project should now be valued using willingness to pay measures. Water conservation activities include: reducing the level or altering the time pattern of demand by metering, leak detection and repair, rate structure changes, regulation on use, education programs, and drought contingency planning; modifying management of existing water development and supplies by recycling, reuse, and pressure reduction; and increasing upstream watershed management and conjunctive use of ground and surface waters. A specific cost-benefit methodology was constructed to accomodate the revisions in rules and procedures. In addition to being consistent with federal mandates, this technique offers important advantages over the traditional requirements approach to water supply planning. The advantages of this approach are largely the result of utilizing water demand functions, together with water supply functions, in the evaluation procedure. Use of demand functions is recommended because these functions implicitly incorporate pricing as well as those technical opportunities for water conservation which are known to have positive net benefits. Use of demand functions also permits willingness to pay measures to be calculated for specific projects. (Moore-IVI)
W84-01930

ESTIMATION OF DIRECT IRRIGATION BENEFITS,
Colorado State Univ., Fort Collins. Dept. of Economics.
R. K. Sampath.
Water Resources Bulletin, Vol. 19, No. 3, p 469-476, June, 1983. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Irrigation, *Mathematical models, *Benefits, Water demand, Population dynamics, Estimating, Water supply.

For optimal allocation of resources, it is critical to arrive at proper estimations of direct benefits created by irrigation projects. The traditional and new methods of estimation of direct benefits from irrigation development were reviewed, highlighting the theoretical implications of these methods. Comprehensive formulas were derived to show the extent of bias in these methods. Since irrigation benefits occur over a long period of time, the dynamic aspects such as shifts in demand and supply functions for commodities due to changes in income, population, and technology cannot be overlooked. Ignoring these important dynamic aspects will lead to underestimation or overestimation of direct benefits. Shifts in demand that occur over time due to population growth are incorporated in a theoretical model for estimation of direct irrigation benefits. Formulas were derived for the estimation of total surplus and its distribution between consumers and producers. (Moore-IVI)
W84-01933

NATURE OF LONG RUN COST SAVINGS DUE TO WATER CONSERVATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
Water Resources Bulletin, Vol. 19, No. 3, p 489-498, June, 1983. 8 Fig, 1 Tab, 10 Ref.

Descriptors: *Water conservation, *Foregone costs, Water resources development, Water supply facilities, Construction costs, Maintenance costs, Costs, Economic aspects, Capital.

Savings in capital, operation, and maintenance cost of new water supply facilities are referred to as 'long run foregone costs.' Any conservation measure leads to reduction of water use or loss; however, significant long run foregone costs are realized only when reductions in size or delays in construction of facilities result. In order to accurately evaluate these costs it is necessary to know which facilities are affected and how they are affected (eliminated, downsized, or delayed). The effects of several levels of conservation on long run foregone costs for an actual study are presented and some easy to use equations are derived that may be used to calculate such savings. Long run foregone costs resulting from water conservation are more dependent on the size and construction year of new water supply facilities than on the reduction in water use or loss. The foregone cost functions are not only frequently nonlinear, but they may be discontinuous. This is especially true when the decision to build or not to build a large facility at a fixed date must be made. If a facility affected by conservation is scheduled to be built within roughly five years of the beginning of the planning period, it is more economical to downsize the facility. If it is to be built later in the planning period, it is more economical to delay construction. (Moore-IVI)
W84-01936

EVALUATION OF OPERATIONAL CLOUD SEEDING PROJECTS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 3B.
W84-01940

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PRICE BEHAVIOR IN THE WATER MARKET OF NORTHEASTERN COLORADO,
Colorado State Univ., Fort Collins. Dept. of Economics.
R. L. Gardner, and T. A. Miller.
Water Resources Bulletin, Vol. 19, No. 4, p 557-562, August, 1983. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Prices, *Water market, *Colorado-Big Thompson water, Water shares, Irrigation water, Industrial water, Municipal water, Colorado.

Past prices of Colorado-Big Thompson water shares were analyzed using an asset pricing model which incorporated the growth rate in real returns to irrigation water and the value of potential urban water uses. A real growth rate in the returns to irrigation water was estimated at 5.3%. Nevertheless, market values for water shares have exceeded capitalized agricultural values since 1969. Historically, urban use potential was heavily discounted, but the implicit discount rate fell rapidly in the last decade. The expectation that water shares will eventually be sold to municipal or industrial consumers now appears to be reflected fully in water prices. The real value for an acre-foot share of Colorado-Big Thompson water is not expected to rise much above its 1980 real market value of $2,895. Prices in this range appear to fully reflect the willingness-to-pay for municipal and industrial water. Continuation of the present situation of high nominal interest rates and relatively low inflation rates will likely keep water prices below this level. (Moore-IVI)
W84-01939

DISTRIBUTIONAL ISSUES IN WESTERN MUNICIPAL AND INDUSTRIAL WATER SUPPLY,
Utah Univ., Salt Lake City. Dept. of Economics.
J. R. Miller, and D. A. Underwood.
Water Resources Bulletin, Vol. 19, No. 4, p 631-640, August, 1983. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Financing, *Repayment, *Municipal water, *Industrial water, *Irrigation water, Central Utah Project, Bonneville Unit, Utah, Cost allocation, Water allocation, Water policy.

Financing and repayment provisions of western water projects effect transfer of income among federal taxpayers, electric power users, local water users, and property owners. The Bonneville Unit of the Central Utah Project (CUP) is used as a case study in the distribution of municipal and industrial water costs. Bonneville Unit water is developed in two basins, 164,500 acre-ft or 53% in the Unita Basin and 148,500 acre-ft or 47% in the Bonneville Basin. Only 27,900 acre-ft of project water, less than 9%, remains in the Uinta Basin. The project is

at least nominally an irrigation project, as 66% of the water is committed for that purpose. The distribution of costs among taxpayers and water users in different political/geographical jurisdictions, and how this distribution is affected by water law, cost allocation procedures, and the choice of revenue source for local repayment of reimbursable costs were examined. Irrigation water is heavily subsidized, both in terms of the zero interest provision and the reliance on Basin Fund revenues for irrigation repayment. Some counties bear a portion of the cost of municipal and industrial water without receiving any of it. In counties which receive water, costs are shared between water users and property taxpayers. Except for the counties receiving no water, there is a close correspondance between the financial contribution and water received. The interest subsidy on municipal and industrial water repayment of implementation present water policy, the lack of open debate on water issues is unfortunate. (Moore-IVI)
W84-01950

PRICING IRRIGATION WATER IN DEVELOPING COUNTRIES,
North Carolina State Univ. at Raleigh. Dept. of Economics and Business.
J. A. Seagraves, and K. W. Easter.
Water Resources Bulletin, Vol. 19, No. 4, p 663-672, August, 1983. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Pricing, *Developing countries, *Irrigation, Marginal cost, Economic aspects, Water supply development.

Alternative combinations of water pricing and regulations are possible in allocating irrigation water. The best combination will depend on the value of water, ability to control deliveries, desire to subsidize agriculture, ownership traditions, crops grown, return flows, drainage problems, staff training, ability to collect fees, and the number of farmers. Marginal cost pricing is explained and identified with a way of thinking about administered prices rather than a rigid system. Alternative pricing schemes are illustrated and some conclusions are offered. Four different pricing systems can be distinguished: direct charges based on measured volumes; direct charges per share of the flow in a stream or canal; direct charges per acre irrigated; and indirect charges on crop outputs marketed or on other inputs purchased. Regulations and prices for irrigation water will reflect conflicting goals. Institutions which are appropriate for regulating and/or pricing irrigation water depend on a number of factors besides the goals. For economic efficiency reasons, it is desirable to base administered prices on the marginal cost of acquiring more water, or on its opportunity cost in alternative uses. However, it is often contended that prices based on marginal costs will be too high for farmers with low incomes. Marginal cost pricing of water has special relevance to seasonal shortages and chronic over-irrigation. Institutions for the management of water from irrigation canals are affected by the ease with which the flow can be measured. When flows are uncertain, shares rather than volumes of the water can be allocated to individual farms. It is not worthwhile to seek greater physical efficiency in all cases. The irrigation system that is economically most efficient depends on the value of water and other variables. (Baker-IVI)
W84-01953

6D. Water Demand

WATER FOR LAS VEGAS METROPOLITAN AREA,
URS Co., Las Vegas, NV.
D. A. Haselhoff.
Journal of Environmental Engineering, Vol. 109, No. 3, p 700-712, June, 1983. 2 Fig, 7 Tab.

Descriptors: *Water demand, *Las Vegas, *Nevada, *Water supply development, Water conservation, Population growth, Groundwater, Water reuse, Arid areas, Urban areas, Water management, Economic aspects.

The Las Vegas area is one of the most arid parts of the driest state in the nation. It is among the fastest growing areas in the nation, and water supplies must be sought and managed to meet the demands of this growth. Water suppplies currently available include groundwater, Colorado River water, and wastewater reuse. New sources of water supply include groundwater stored in adjacent valleys and potentially vast quantities of water stored in deep-carbonate aquifers. Water demand functions were developed by different user classes including residential, commercial, industrial, civic, agricultural and non-agricultural irrigation, and system losses. These functions can assist other planners in determining water use in arid climates. The Las Vegas metropolitan area can manage water resources to meet needs for at least the next 50 years. Unique characteristics of the valley required assessment of all components of the water resource system so that water would be economically available for growth. Projected supply exceeds projected demand through at least the year 2020 considering various factors that can reduce available supply. Projected demand can be reduced by successful water conservation programs. An implementation program was developed to provide economical water by protecting existing supply, managing that supply wisely to meet peak demands, and exploring for new water supply sources when present sources are no longer adequate to meet demands of growth. (Moore-IVI)
W84-01774

MULTICRITERIA ANALYSIS OF WATER ALLOCATION IN A RIVER BASIN: THE TCHEBYCHEFF APPROACH,
Princeton Univ., NJ. Dept. of Civil Engineering.
N. P. Greis, E. F. Wood, and R. E. Steuer.
Water Resources Research, Vol. 19, No. 4, p 865-875, August, 1983. 7 Fig, 5 Tab, 23 Ref.

Descriptors: *Water allocation, *Multicriteria analysis, Computer models, Delaware River Basin, Seasonal water allocation, Linear optimization, Water demand, Comsumptive use.

A new interactive multiple objective methodology is applied to the seasonal water allocation problem. Linear optimization and filtering procedures are combined within a multiobjective framework in order to identify nondominated solutions associated with randomly sampled criteria vectors. The procedure samples from the entire nondominated set, not just the set of nondominated extreme points, by computing the nondominated criteria vector that is closest to an ideal criteria vector according to a weighted Tchebycheff metric. Unlike many other multicriteria methods, the Tchebycheff procedure is capable of finding solutions of highest utility which may not correspond to extreme point solutions. The procedure is applied to the problem of water allocation in the Delaware River Basin where a large number of conflicting objectives, including environmental objectives, compete for the available supply. The basin has large consumptive needs, and demand for water is gradually outstripping supply, causing frequent, often severe shortages in several sectors. (Moore-IVI)
W84-01879

ALTERNATIVE STRUCTURES FOR WATER RIGHTS MARKETS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. W. Eheart, and R. M. Lyon.
Water Resources Research, Vol. 19, No. 4, p 887-894, August, 1983. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Water rights, *Water comsumption, *Permits, Water rights markets, Riparian rights, Economic aspects.

The most important considerations for the the design of systems of marketable permits for water consumption from natural watercourses are those associated with (1) uncertainty of future streamflows and economic conditions, (2) locational issues, and (3) efficient and effective functioning of the markets. In regions presently following the riparian doctrine the most important design decisions include the basis of definition of permit means for initially distributing them, the ty market mechanism used for their transfer after are issued, and the restrictions placed on the and transfer. It is uncertain whether or no PSUR (Prioritized Steady Use Rights) defi basis will be more or less economically eff than the FFR (Fractional Flow Rights) basis PSUR approach has a long-standing precede the appropriative rights system of the we U.S., but the FFR system is operationally sim more easily adaptable to formal market p dures, and more amendable to free initial dis tion schemes in riparian regions. In choosi definition basis, the size of zones, and wheth use a lentic or lotic system, trade-offs may de among economic efficiency, operational simpl and the nonmanipulated functioning of the ma (Moore-IVI)
W84-01882

TEN YEARS TO SLAKE A GLOBAL THI
A. Charnock.
New Scientist, Vol. 97, No. 1348, p 661-66
March, 1983. 5 Fig.

Descriptors: *Water resources develop *Social change, Human diseases, Schistosom Onchocerciasis, Malaria, Latrines, Develo countries, Water supply, Groundwater, P health.

Four-fifths of the diseases in the Third W nations are linked to dirty water and lack of sa tion. Among these diseases are onchocerc schistosomiasis, and malaria. Three out of people in these nations have no easy acces clean water. Attempts to remedy the situation focused mainly on groundwater sources. On the major problems is repair of mechanical eq ment. In most cases the people using the equipr are unable to fix it, should something break do If the machinery is highly sophisticated, then government of that nation must spend lim funds on replacement parts abroad, as their m facturing techniques are not on a par with wh needed to replace the damaged equipment. I cost systems are seen as better for these areas the handpumps taking priority over the more pensive piped water supply schemes. Muc being done with plastics now in place of m parts as plastics are cheaper, light and easy replace. Various latrine designs in regular us the Third World nations are briefly descri (Baker-IVI)
W84-02011

6E. Water Law and Institutions

ACID RAIN: A RAPIDLY SHIFTING SCE
For primary bibliographic entry see Field 5B.
W84-01777

FROM DREAM TO REALITY: LAKE MIC GAN WATER FOR FOUR CHICAGO S URBS,
PRC Consoer Townsend, Inc., Chicago, IL.
For primary bibliographic entry see Field 5F.
W84-01786

GROUNDWATER LAWS: OPPORTUNIT FOR MANAGEMENT AND PROTECTION,
Calhoun, Hubbard, Riddle and Cox, Savann GA.
For primary bibliographic entry see Field 4B.
W84-01789

COST-EFFECTIVE REGULATORY OPTIO FOR WATER QUALITY LIMITED STREAM
Wisconsin Univ.-Madison. Dept. of Economi
For primary bibliographic entry see Field 5
W84-01927

VIEWS OF WESTERN WHITEWATER FLOA ERS TOWARD POSSIBLE SAFETY MEA URES,

LIBRARY U. OF I. URBANA-CHAMPAIGN

h Central Forest Experiment Station, St. Paul,

Schomaker.
r Resources Bulletin, Vol. 19, No. 3, p 463-
June, 1983. 1 Fig, 1 Tab, 9 Ref.

riptors: *Boating, *Recreation, *Safety, *Atti-
, Whitewater boating, Management, Regula-
, Rivers.

a risk recreation activity like whitewater boat-
a manager's goal of providing for the health
afety of the visitor may conflict with the goal
oviding the opportunity for a satisfying recre-
experience. As whitewater river managers
the problem of safety and risks, they should
der what users think about safety programs.
views of whitewater boaters toward (1) first
quipment requirements, (2) signs warning of
rds, (3) aggressive enforcement of the rules,
(4) patrols to assist and regulate users were
mined on 13 river segments in the western
ed States. A test was made of the relation
een viewers toward safety measures and the
of risk and thrills sought by floaters. Conclu-
of the study are: (1) river floaters' views
rd possible management safety measures are
elated to the amount of risk they desire; and
oaters, in general, prefer some safety measures
thers. If safety measures mean that managers
be more visible on the river, floaters tend to
e them. Therefore, a manager's approach to
y management should parallel the approach to
ation management in general, and regulation
e should be the minimum necessary to achieve
y objectives. (Author's abstract)
-01932

TREAM-DOWNSTREAM: RIGHTS AND
PONSIBILITIES,
nical Univ. of Nova Scotia, Halifax. Dept. of
Engineering.
. Waller.
adian Journal of Civil Engineering, Vol. 10,
3, p 362-368, 1983. 2 Fig, 2 Tab, 3 Ref.

criptors: *Storm runoff, *Legal aspects,
ada, Riparian rights, Drainage effects, Storm
r, Natural watercourses, Land development,
ic policy, Flood damage, Downstream.

engthy trial in the Supreme Court of Nova
ia may influence design of future stormwater
ems in Canada. The developer of a 203 ha area
an upstream developer and the provincial
artment of transportation, claiming real and
cipated damages from increased flows and vol-
s of stormwater. The plaintiff claimed that it
entitled to have the defendants reduce quanti-
and rates of flow, or to have costs of enlarging
ystem paid by the defendants. The Court con-
ed that the defendants were not required to
rict flows to pre-development levels as long as
used natural watercourses and did not cause
r natural capacity to be exceeded. The down-
am owner is obligated to accept the increased
s, to design watercourse modifications to ac-
odate these flows, and to base his determina-
of flows on a 100 year rainfall event. An
rect result of the court case, and of the situa-
that produced it, was the creation of the
ifax County Storm Drainage Task Force. Most
he problems that led to the court case would
e been avoided if the policies and criteria had
n in place to guide the activities is both up-
am and downstream developers. If cost-effec-
implementation of stormwater policies and
eria is to be achieved, preparation of drainage
ter plans and development of cost-sharing
hanisms are essential. (Moore-IVI)
4-01982

FECT OF THE 1981/82 WINTER ON WATER
PPLIES,
primary bibliographic entry see Field 5F.
4-01991

IORITY POLLUTION RIGHTS: ADAPTING
LLUTION CONTROL TO A VARIABLE EN-
RONMENT,
Colorado Univ., Boulder. Dept. of Economics.
C. W. Howe, and D. R. Lee.
Land Economics, Vol. 59, No. 2, p 141- 149, May, 1983. 1 Fig, 13 Ref.

Descriptors: *Water pollution control, *Legal aspects, Appropriation, Environment, Waste disposal.

Variability in the assimilative capabilities of the environment and in demands for the waste disposal services of the environment pose difficult problems for pollution control systems. A feature is proposed for pollution rights systems that is expressly designed to deal with environmental variability in an economically efficient manner. The system is referred to as a priority pollution rights system (P.P.R.S.). It is an adaptation of the long standing system of appropriations doctrine found in western U.S. water law. The P.P.R.S. has much greater flexibility and makes more efficient use of privately held technological and cost information than alternative instruments of control in adapting pollutant discharge rates to variations in the assimilative capabilities of the environment. Possibilities of undesirable forms of strategic behavior in the market warrent further study, but such possibilities exist under all instruments. Successful experience with priority water rights in the western U.S. bodes well for similar systems in the field of pollution control. (Baker-IVI)
W84-02049

6F. Nonstructural Alternatives

ENHANCED ROLE OF WATER CONSERVATION IN THE COST-BENEFIT ANALYSIS OF WATER PROJECTS,
Texas A and M Univ., College Station. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W84-01930

6G. Ecologic Impact Of Water Development

EX POST FACTO ANALYSIS OF THE REGIONAL ECONOMIC IMPACT OF EXPENDITURES FOR RESERVOIR RECREATION,
Texas Agricultural Experiment Station, College Station. Dept. of Recreation and Parks.
J. H. Gramann.
Journal of Environmental Management, Vol. 16, No. 4, p 357-367, June, 1983. 5 Tab, 14 Ref.

Descriptors: *Reservoirs, *Recreation, *Economic impact, Economic justification, Water resources development, Management, Prediction, Illinois.

A comparison is made between the predicted and actual economic impact of recreation expenditures at a reservoir in the state of Illinois. Although originally designed for multiple uses, the reservoir is justified primarily in terms of recreation. Expenditure data collected from a representative sample of reservoir visitors are utilized in an input-output analysis to determine the direct, indirect, and induced effects of these expenditures on personal income in the two counties in which the reservoir is located. Recreation expenditures directly and indirectly accounted for 1.3% of total personal income in the two-county region, which contrasts sharply with the optimistic forecasts of civic boosters and project planners. Several criticisms of pre-reservoir economic impact assessments are made. Among these are their focus on total recreation expenditures rather than on income derived from expenditures, and the failure of project supporters to distinguish spending by local from non-local visitors. Both practices inflated considerably the predicted impact of recreation expenditures. Input-output matrices for the area show the retail sector of the economy to be relatively independent of other economic sectors. Although the impact of recreation expenditures is felt mostly in retail enterprises, the low level of retail development, together with that sector's structural independence, indicates that overall economic impacts will continue to be small. (Author's abstract)
W84-01829

SEDIMENTATION, ACCRETION, AND SUBSIDENCE IN MARSHES OF BARATARIA BASIN, LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W84-01835

EFFECTS OF REGULATION OF THE RIVER TEES UPON FISH POPULATIONS BELOW COW GREEN RESERVOIR,
For primary bibliographic entry see Field 2H.
W84-01837

FISH OF CHANNELIZED AND UNCHANNELIZED SECTIONS OF THE BUNYIP RIVER, VICTORIA,
James Cook Univ. of North Queensland, Townsville (Australia). School of Biological Sciences.
For primary bibliographic entry see Field 2H.
W84-01839

EFFECTS OF IMPOUNDMENTS ON DOWNSTREAM BED MATERIALS OF TWO UPLAND RIVERS IN MID-WALES AND SOME ECOLOGICAL IMPLICATIONS OF SUCH EFFECTS,
Ministry of Agriculture and Water Development, Lusaka (Zambia).
J. Scullion.
Archiv fur Hydrobiologie, Vol. 96, No. 3, p 329-344, March, 1983. 3 Fig, 4 Tab, 39 Ref.

Descriptors: *Rivers, *Environmental effects, *Impoundments, Flow rates, Macroinvertebrates, Physical properties, Substrates, Wales.

Physical properties of substrate such as particle size composition, gravel porosity, organic matter content, permeabilities, and apparent water velocities of two regulated and two unregulated rivers were studied over a period of about one year. During this period these properties did not change appreciably, despite substantial flow fluctuations of unregulated rivers. There were few significant differences between regulated and unregulated rivers despite the elimination or reduction of summer and autumn spates by regulation. The most ecologically important effects of regulation on the macroinvertebrate fauna would seem to be the occlusion of bed surfaces by deposits, rich in iron and manganese derived from storage reservoirs, and changes in the temperature regime. The effects of regulation on salmonid egg survival are also discussed. (Baker-IVI)
W84-01843

ATTEMPTED RECONSTRUCTION OF THE FAUNA OF LARGE RIVERS AND FLOOD PLAINS OF EUROPE (VERSUCH EINER REKONSTRUKTION DER FAUNA EUROPAISCHER STROME UND IHRER AUEN),
E. J. Fittkau, and F. Reiss.
Archiv fur Hydrobiologie, Vol. 97, No. 1, p 1-6, May, 1983. 6 Ref.

Descriptors: *Rivers, *Fauna, *Flood plains, Aquatic life, Nutrients, Flooding, Europe.

The fauna of the large European rivers has been destroyed before it was possible to carry out a full investigation. The destruction of this fauna has been brought about not only through canalization of the rivers for ship traffic but also through the introduction of industrial effluents and the cultivation of the flood plains. The flood plains, with their numerous small and large lotic and lenitic waters, together with the river constitute an ecological entity. The habitats 'Fluss-Aue' are continuously formed and preserved through flooding and have been the place producing the basic nutrient component for the zoocoenoses of the river and the hatching area for migrating fishes. The waters of the flood plains, by their enormous continuity, in time, become of great significance for the evolution of the aquatic fauna. (Author's abstract)
W84-01846

ANALYSIS OF DISSOLVED OXYGEN CONCENTRATIONS IN TAIL WATERS OF HYDROELECTRIC DAMS AND THE IMPLICATIONS FOR SMALL-SCALE HYDROPOWER DEVELOPMENT,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. F. Cada, K. D. Kumar, J. A. Solomon, and S. G. Hildebrand.
Water Resources Research, Vol. 19, No. 4, p 1043-1048, August, 1983. 3 Fig, 2 Tab, 14 Ref. DOE contract W-7405-eng-26.

Descriptors: *Hydroelectric power, *Dissolved oxygen, *Tailwater, Dam effects, Environmental effects, Water quality, Seasonal variation, Small-scale hydropower.

Dissolved oxygen concentrations in reservoir tail waters from operating hydroelectric sites were paired with dissolved oxygen measurements from nearby downstream Geological Survey water quality stations. A total of 65 small-scale hydroelectric sites were selected, of which four did not have both winter and summer dissolved oxygen data; 74 large-scale hydroelectric sites were paired with nearby water quality stations, three of which did not have both winter and summer data. These data were used to calculate probabilities of noncompliance (PNC's), that is, the probabilities that dissolved oxygen concentrations in the discharge waters of operating hydroelectric dams will drop below 5 mg/l. The continental states were grouped into eight regions based on geographic and climatic similarities. Most regions had higher mean PNC's in summer than in winter, and summer PNC's were greater for large-scale than for small-scale hydropower facilities. PNC's were generally less than 0.05 during the winter months, regardless of generating capacity. Cumulative probability distributions of PNC also indicated that low dissolved oxygen concentrations in the tail waters of operating hydroelectric dams are phenomena largely confined to sites with large-scale facilities. PNC's are not a function of electrical capacity per se but rather appear to be dependent upon factors related to capacity, such as reservoir depth. Potential dissolved oxygen problems are unlikely to hinder small-scale hydropower development in the U.S. (Moore-IVI)
W84-01896

RECREATION AT DRINKING WATER RESERVOIRS IN MASSACHUSETTS: A SURVEY OF WATER MANAGERS,
Massachusetts Univ., Amherst.
L. R. Klar, Jr., and A. Ghirin.
Water Resources Bulletin, Vol. 19, No. 3, p 477-481, June, 1983. 5 Tab, 12 Ref. OWRT WRA 107-MASS.

Descriptors: *Reservoirs, *Recreation, *Massachusetts, *Water pollution sources, Drinking water, Fishing, Water management, Municipal water, Attitudes, Regulations, Watersheds.

The recreational use of public drinking water reservoirs in Massachusetts is quite limited, particularly in comparison to other parts of the country. A survey was conducted of 51 municipal water supply managers in Massachusetts. Water officials were found to advocate highly restrictive views. Of the agencies owning or controlling their own reservoirs, 62.5% had policies prohibiting all recreational activities on their reservoirs or surrounding watershed areas. Fishing was the most common activity allowed among agencies permitting recreation. Managers from agencies owning or controlling no reservoirs were more likely to favor recreation to a significant degree. No officials said that recreation was an insignificant source of water supply pollution, and opinions were not found to be related to respondents' exposure to the literature on the topic. The majority of managers were not familiar with the literature assessing the impact of recreation on water supply reservoirs. (Moore-IVI)
W84-01934

NEW COURSE FOR THE NILE,
A. Charnock
New Scientist, Vol. 100, No. 1381, p 285-288, 27 October, 1983. 9 Fig.

Descriptors: *Water resources development, *Enviromental effects, *Social change, Canals, Nile River, Sudan, Jonglei Canal.

A 50 year old plan to divert the Nile away from the swamps of south Sudan is nearing completion. The Jonglei Canal should improve communications and agriculture, but the effects on the local populations are not clear. The Canal will divert a quarter of the White Nile's waters in a 360 km channel that will bypass the Sudd swamps, 600 km south of Khartoum where more than half of the Nile's flow evaporates every year. The canal should shrink the swamps and their floodplains, and present the first man-made barrier to a cycle of pastoral migration which has existed for thousands of years. Opportunities to expand health services will be improved. The major concern is the possible spread of the schistosome parasite. (Baker-IVI)
W84-02010

CHANGES IN THE SEDIMENTARY FLUXES IN LAKE WALCHENSEE BY ANTHROPOGENICALLY CAUSED ALTERATIONS OF ITS CATCHMENT AREA (VERANDERUNGEN IM SEDIMENTATIONSGESCHEHEN DES WALCHENSEES DURCH ANTHROPOGENE EINGRIFFE IN DAS EINZUGSGEBIET),
C. Steinberg, E. Hammerle, and J. Meilhammer.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 2, p 48-54, 1983. 11 Fig, 14 Ref.

Descriptors: *Environmental effects, *Sediment transport, *Diversion, Catchment areas, Lake Walchensee, Upper Isar River, Rissbach Brook, West Germany, Calcium, Phosphorus, Chlorophyll, Plant pigments, Wastewater, Agricultural runoff, Water resources development, Land development.

Diversion of the Upper Isar River (since 1924) and the brook Rissbach (since 1950) into Lake Walchensee (Upper Bavaria, Germany, F.R.) for energy purposes enlarged the lake's catchment area from 59.3 sq km to 783.6 sq km. The catchment area of the Upper Isar River contributes 510 sq km. Since the diversions drain into different bights of the lake, their effects on biogeochemical cycling in the lake can be studied by determination of the sedimentary fluxes in the corresponding bight. The annual sedimentary fluxes of calcium, phosphorus and plant pigments (chlorophyll a and degradation products) for the two bights receiving the diversions are compared with the flux in a third bight not influenced by a diversion. The diversion of the Upper Isar River increased the sedimentary flux of calcium from 30 to 900 g/sq m/a Ca. This value is more or less constant since the mid fifties. The phosphorus flux increased from 100 to 1,000-1,500 mg/sq m/a P and reached maximum values of 2,500 to 7,400 mg/sq m/a since the end fifties. These increases are due to the development of various tourist facilities, e.g. mountain-railways etc., as well as increase in wastewater quantities, and agricultural intensification in the catchment area. The sedimentatary flux of plant pigment reflects this situation. Prior to 1924, less than 6.0 mg/sq m/a pigment were sedimented, between 1924 and 1957, 30 to 80 and thereafter up to 330 mg/sq m/a. The diversion of the brook Rissbach into the lake led to a sedimentary flux of calcium of 1 to 3 kg/sq m/a with decreasing rates in the past five years. This is also true for the phosphorus sedimentary flux since about 1971: in the most recent layers the data oscillate around 2,000 mg/sq m/a P. This value is only about one third of the flux influenced by the River Isar. There is a steady increase in the deposition of plant pigments since 1960. (Moore-IVI)
W84-02062

7. RESOURCES DATA

7B. Data Acquisition

WATER CENTRE DEVELOPS GROUND RADAR,
J. Bell.
New Scientist, Vol. 98, No. 1363, p 870-871, 2 June, 1983. 2 Fig.

Descriptors: *Ground radar, *Sewer systems, Leakage, Pipelines, Collapse, Mapping.

Five thousand of the big holes that appear in Britain's roads every year may be blamed on collapsed or blocked sewers. Ground radar, to spot the voids that sewers fall into, is now in the experimental prototype stage. The theory is that if radar could detect voids outside the sewers (often caused by burst sewers leaking and washing soil away) then it should be possible to prevent some of the expensive collapses. The prototype, which consists of two antennas in a perspex tube, is a variable frequency machine. It has to be variable because radar penetration underground may change randomly according to the presence or absence of gaps, stones, water, sand, and so on. Damage to sewers may also be prevented by electronic mapping, thus avoiding the loss of sewer and water mains over the years through the lack of accurate records as to their original placement. (Baker-IVI)
W84-02013

8. ENGINEERING WORKS

8A. Structures

OPTIMUM DESIGN OF SMALL RESERVOIRS (TANKS),
California Univ., Davis. Dept. of Civil Engineering.
O. J. Helweg, and P. N. Sharma.
Water Resources Research, Vol. 19, No. 4, p 881-885, August, 1983. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Design criteria, *Reservoirs, Tanks, India, Arid regions, Construction, Model studies.

Small reservoirs, called tanks, are part of traditional water transport methods in the semiarid tropics of India and other countries. While considerable investment is being planned to construct more of these tanks, no investigation has been made to determine the most efficient design for them. Assuming the most efficient operating policy and tank location, there are two separable optimization problems in designing a small tank or reservoir irrigation system. The first deals with optimal tank dimensions and the second with optimal storage capacity. The size of a tank irrigation system may either be constrained by the catchment area available for producing runoff and/or the limited area suitable for irrigation. An example of a small reservoir irrigation system for Hyderabad region in south India is presented as a demonstration of the method of design. (Baker-IVI)
W84-01881

EROSION IN RELATION TO FILTER DESIGN CRITERIA IN EARTH DAMS,
California Univ., Davis.
For primary bibliographic entry see Field 8D.
W84-01958

8B. Hydraulics

MOUND FORMATION AT CULVERT OUTLETS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. R. Abt, J. F. Ruff, and C. Mendoza.
Water Resources Bulletin, Vol. 19, No. 4, p 571-576, August, 1983. 6 Fig, 13 Ref.

Descriptors: *Scour, *Culverts, *Mound formation, Bed erosion, Sediment transport, Tailwater, Jets, Sediment deposition.

Culvert installations along transportation routes often alter natural drainage flow conditions. Local scour results when the channelized flow impacts the bed material. One component of the local scour process near a culvert outlet is the formation of an aggraded mound downstream of the scour area. A

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of experiments was performed in which a ontally cantilevered pipe discharged water a bed of sand material. The impacted jet orted material away from the jet, subse- ly depositing material downstream of the hole. The maximum dimensions of the d were correlated to the discharge intensity, .5)D(-2.5), the maximum dimensions of the hole, time, and tailwater evaluation. The r the tail water elevation, the higher the d. The area of influence could be expressed in of the length of scour, length of mound, and of mound or as a function of the hydraulic eters. (Moore-IVI)
01941

LISTIC ASSESSMENT OF MAXIMUM OD POTENTIALS,
rimary bibliographic entry see Field 2E.
01962

V DEPTH IN SAND-BED CHANNELS,
Tech, Inc., Pasadena, CA.
Brownlie.
al of Hydraulic Engineering, Vol. 109, No. 7, 990, July, 1983. 17 Fig, 3 Tab, 46 Ref. NSF CME79-20311.

iptors: *Friction, *Flow depth, *Channels, discharge, Slope, Water depth, Mathematical s, Statistical analysis, Dimensional analysis, el hydraulics, Bed load, Dunes, Ripples, An- s.

ethods of predicting friction factor are evalu- nd a new method is presented which better ts flow depth (and therefore friction factor) discharge and slope values are known. The f the investigation is to define a relationship en depth, discharge, and slope that can be n a wide range of situations where uniform onditions are present and which can also be d for numerical modeling applications. None six methods completely satisfy the writer's a; therefore a new relationship is presented. roposed technique is based on dimensional is, a statistical analysis of a large body of tory and field data, and basic principles of ilics. Separate equations are developed for ver (dune and ripple) and upper (flat bed and ne) flow regimes. The technique also in- a simple method for flow regime determina- Finally, the proposed method is verified h comparison with data sets not used in the tion of the technique. (Author's abstract) 1963

FLOW VELOCITY IN SHORT RIVER S,
ische Hogeschool, Delft (Netherlands). of Civil Engineering.
e Vriend, and H. J. Geldof.
l of Hydraulic Engineering, Vol. 109, No. 7, -1011, July, 1983. 10 Fig, 1 Tab, 29 Ref.

ptors: *Flow velocity, *River bends, Mathe- l models, Flow convection, River beds, re gradients, Netherlands, River Dommel.

s of a mathematical model for the depth- ed main flow velocity in shallow river bends mpared with measurements in two consecu- harply-curved short bends in the river el, The Netherlands. The computed main y distribution agrees rather well with the red one in the larger part of each bend. Near nd, deviations occur which indicate the sec- flow convection should be included in the natical model. The inward skewing tenden- he velocity distribution near the entrance of is due to main flow inertia combined with gitudinal pressure gradients arising from the n of the transverse surface slope. In the river under consideration, the gradual outward f the main velocity maximum further down- in the bend is a matter of retarded adapta- f the flow to the bed configuration, rather f secondary flow convection. Secondary onvection is only important in the last part h of the surveyed bends; there it seems to hamper the outward skewing of the flow instead of enhancing it. As the flow stage becomes higher, the main velocity maximum tends to shift towards the inner bank; this must be attributed to the reduced asymmetry of the channel rather than to the slower development of the secondary flow. (Moore-IVI)
W84-01964

FLOOD PLAIN AND MAIN CHANNEL FLOW INTERACTION,
Birmingham Univ. (England). Dept. of Civil Engineering.
D. W. Knight, and J. D. Demetriou.
Journal of Hydraulic Engineering, Vol. 109, No. 8, p 1073-1092, August, 1983. 19 Fig, 2 Tab, 14 Ref.

Descriptors: *Flood plains, *Channel flow, Shear stress, Shear force, Model studies, Hydrologic models, Channel roughness.

Experimental results are presented concerning the discharge characteristics, the boundary shear stress and boundary shear force distributions in a compound section comprising of one rectangular main channel and two symmetrically disposed flood plains. The experiments were conducted in a 15 m flume, 610 mm wide. Two flood plains, 76 mm high and 229 mm wide were added, creating a symmetrical cross section with a center channel 152 mm wide and 76 mm deep. The apparent shear force acting on the vertical interface between one flood plain and the main channel is strongly depth dependent. The apparent shear forces are always positive, indicating that the flood plain retards the main channel flow. Equations are presented giving the proportion of the total flow which occurs in the various sub areas. The division of flow based on linear proportion of the areas is inadequate on account of the interaction between the flood plain and main channel flows. The experimental results apply only to the case in which the flood plains have the same roughness as the main channel and are symmetrically disposed. (Moore-IVI)
W84-01966

MODELLING OF DISCONTINUITIES THROUGH DIPOLE DISTRIBUTION,
Thessaloniki Univ., Salonika (Greece). Lab. of Hydraulics and Hydraulic Works.
E. Sidiropoulos, C. Tzimopoulos, and P. Tolikas.
Applied Mathematical Modelling, Vol. 7, No. 5, p 306-310, October, 1983. 6 Fig, 10 Ref.

Descriptors: *Dipole distribution, *Dams, *Sheet-piles, *Discontinuities, *Flow, Mathematical models, Boundary element methods, Singularities.

The problem of the flow under a dam with a sheet-pile in its foundation is treated as a characteristic example of the introduction of dipoles in order to model the discontinuity in the potential function across the cut-off wall. Dipole singularities were used in order to account for the presence of a sheet-pile in the flow. The method is not restricted to a single pile. The same procedure can be applied to the case of more sheet-piles and of arbitrary inclination. The width of the sheet-piles is taken to be zero and the dipoles are placed along the axis of the sheet-piles. A linear boundary element was placed at the tip of the sheet-pile. The coefficients of the linear system of equations are all given in analytical form and no partition into zones is necessary. Very good agreement with analytical results is demonstrated, the mean absolute relative deviation being of the order of 4%. With the insertion of a linear element at the tip of the sheet-pile it was possible to obtain the same value of the potential on both faces of the sheet-pile at that point. (Moore-IVI)
W84-01997

TURBULENCE STRUCTURE OF DILUTE DRAG-REDUCING POLYMER SOLUTIONS IN A RECTANGULAR OPEN CHANNEL FLOW,
Yamaguchi Univ. (Japan). Dept. of Chemical Engineering.
H. Usui, and Y. Sano.
AIChE Journal, Vol. 29, No. 4, p 611-617, July, 1983. 11 Fig, 20 Ref.

Descriptors: *Drag, *Open channels, *Polymers, *Turbulent flow, Velocity, Drag reduction, Bursting, Discharge capacity, Eddies.

The drag reduction phenomenon in a rectangular open channel flow was examined by measuring the longitudinal velocity by means of a laser Doppler anemometer. Drag reduction was detected using 50 and 100 ppm polymer additives (polyethylene oxide). Statistical analysis of the fluctuating velocity showed that the most significant effect of the polymer additive on the large-scale turbulent motion appeared in the turbulent core of an open channel flow. The scale of bursting phenomenon was enlarged by the polymer additive, and the typical ejection process was detected as the remarkable negative fluctuating velocity throughout the buffer and turbulent core regions except near the free surface. The maximum increase of discharge capacity was 40% of the Newtonian fluid case. The skewness factor of polymer solutions showed anomalously high negative value at $y(+) = 70$ to 120. The corresponding flatness factor was much larger than that of water. These observations were interpreted as an increased scale of the large eddy motion in polymer solutions and as the results of suppression of sweep process because of the existence of free surface. (Moore-IVI)
W84-02001

8C. Hydraulic Machinery

DESIGN OF IN-LINE JET INJECTION BLENDERS,
Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven, and L. Benefield.
Journal of the American Water Works Association, Vol. 75, No. 7, p 357-363, July, 1983. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Mechanical equipment, *Design criteria, Blenders, Injection, Water treatment.

Available information on the initial mixing characteristics of turbulent jets in crossing pipe flow is reviewed, and criteria is given for the optimum design of in-line jet injection blenders. A previously proposed design procedure for centrally injected jets is discussed, and an analysis is presented to indicate how this procedure can be improved. Both the velocity ratio and the diameter ratio should be considered as design variables in the design of in-line jet injection blenders. Optimum conditions for small diameter ratios are characterized by a constant value for the momentum ratio, whereas the optimum momentum ratio for large diameter ratios is not a constant and depends on the diameter ratio. The central jet injection scheme has several advantages as a rapid mix method compared with the side jet injection scheme, and experimental studies are needed to quantify the optimum conditions for the case of central jets. (Baker-IVI)
W84-01800

PUMPS THAT PLAY TURBINES,
Engineering-Science, Inc., Arcadia, CA.
K. R. James.
Water Engineering and Management, Vol. 130, No. 7, p 32, 34, 36, July, 1983. 2 Fig.

Descriptors: *Pumps, *Turbines, *Hydraulic equipment, Energy, Water distribution.

Engineers are now considering standard centrifugal pumps, operating in reverse as hydroelectric turbines to economically tap hidden potential sources of revenue in water distribution systems. Several alternatives can be considered to take full advantage of the economic benefits which can be realized in using reverse pump turbines. Select only those reverse-pumps which have the broadest possible operating range at reasonably high efficiencies. Use multiple turbines to operate singly or in various combinations to match the expected variations in flow and head. Switch turbines at various stages in the life of the hydro station to correspond with changing flow and head conditions. Install reverse pumps which, by changing impellers, can be converted in the future to operate

at different conditions of flow and head. Use a generator which can operate at two different shaft speeds. (Baker-IVI)
W84-01914

8D. Soil Mechanics

GEOPHYSICAL METHOD OF EVALUATING EXISTING EARTH EMBANKMENTS,
Davenport/Hadley Ltd., Golden, CO.
L. M. Hadley.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 3, p 289-295, August, 1983. 10 Fig.

Descriptors: *Earth dams, *Seismic properties, *Measuring instruments, Soil mechanics, Dam failure, Dams, Safety, Seismographs.

Earth embankments need periodic inspection and monitoring, especially, if settlement or damage is suspected. Currently, earth embankment condition is evaluated through visual inspection and analysis of data from instrumentation such as piezometers and inclinometers. A program to evaluate the condition of existing earth embankments using geophysical methods was developed and is currently being used as part of a safety evaluation of existing earth embankments in the western United States. The geophysical method utilizes the 'common offset' seismic refraction technique which emphasizes areas of change. Seismic lines are run along the dam axis and toe. Anomalous areas, if any, are targeted for drilling. This technique was applied to about 15 dams. A base line data file will be established for all the major earth dams in the United States. New seismic lines could then be run after a dam has undergone an event such as an earthquake and the two sets of data compared. More detailed information will be gained from the seismic data as the program continues and drilling data become available for direct comparison. If a correlation is found between seismic characteristics and physical properties, the amount of drilling required in future studies of settlement at earth embankments should be greatly reduced. (Baker-IVI)
W84-01814

RECONNAISSANCE ESTIMATES OF SUBSIDENCE ALONG SALT-GILA AQUEDUCT, ARIZONA,
Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 3, p 297-315, August, 1983. 16 Fig, 1 Tab, 32 Ref.

Descriptors: *Subsidence, *Aqueducts, Design criteria, Canals, Construction, Groundwater depletion, Arizona, Salt-Gila Aqueduct.

A new approach was recently tested for prediction of subsidence along the Salt-Gila Aqueduct. This concrete-lined aqueduct is 104 km long and follows basin margins eastward of Phoenix, Arizona. Prominent subsidence started with an intensification of ground-water pumpage in the 1940's. Available annual leveling data along the alinement extend from 1971-1978. It was assumed that the 1971-76 subsidence amounted to 20% of past subsidence occurring during overdraft of ground water. Experience with other studies indicated that future residual subsidence along the aqueduct caused by pre-1976 overdraft could be equal to the amounts of past subsidence. Estimated declines of ground water between 1976 and 2005 and between 1976 and 2020 were calculated to be respectively 16% and 22% of the 1923-76 decline in the northern portion and 65% and 112% in the southern portion of the alinement. These ratios were used for estimates of post-1976 subsidence caused by pre-2005 and pre-2020 overdrafts (assuming constant ratios between subsidence and overdraft). Maximum estimated subsidence was 1.91 m for 2005 and 2.09 m for 2020. However, this subsidence will not be achieved for many years after 2005 and 2020. The amount of actual 1976-2005 and 1976-2020 subsidence was estimated using an assumed 30-year half-life of residual subsidence. The values were up to 0.96 m for the year 2005 and up to 1.30 m for the year 2020. These rough estimates were made at a cost of less than $10,000 and verified the sophisticated costly preconstruction estimate. A similar comparison of 2-3 independent estimates appears to be a sound approach for all large projects. (Author's abstract).
W84-01815

INEXPENSIVE TECHNIQUE TO MEASURE SUBSIDENCE ALONG CANALS,
Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region.
N. P. Prokovich, and H. J. Hall.
Bulletin of the Association of Engineering Geologist, Vol. 20, No. 3, p 317-323, August, 1983. 7 Fig, 110 Ref.

Descriptors: *Canals, *Subsidence, *Irrigation canals, Soil mechanics, Water depth, Delta-Mendota Canal, Friant-Kern Canal, California.

Irrigation canals, particularly in dry areas, are frequently affected by land subsidence. Monitoring of such subsidence is essential for operation, maintenance and possible rehabilitation of canals. Periodic leveling of canal alignments is expensive, time consuming, and locally may be obscured by tectonic movements. An inexpensive and rapid method for the measurement of subsidence by determining the depth of water in canals, as applied in the Mid-Pacific Region, is described below. Large canals are divided into pools by check structures which are designed to control or to stop water flow by the manipulation of check gates. For subsidence studies, depth of water in a canal is measured at the upstream and downstream ends of all pools during standstill time with check gates completely closed. Actual depth of water may be different in different pools, but the difference of depth at downstream and upstream ends of each pool corresponds to the invert gradient of a pool and is constant in stable areas. The difference changes, however, in pools affected by subsidence. These changes reflect the amount of subsidence during the time interval between consecutive sets of measurements. In particularly long pools additional depth measurements can be made at convenient strucure sites, such as bridges. This method was used for rough measurements of subsidence in the Delta-Mendota and Friant-Kern Canals in California. (Author's abstract)
W84-01816

MEASURING THE CONTRIBUTION OF LAND AND WATER TO AGRICULTURE,
Idaho Univ., Moscow. Dept. of Agricultural Economics.
R. B. Long.
Water Resources Bulletin, Vol. 19, No. 4, p 613-617, August, 1983. 6 Tab, 3 Ref.

Descriptors: *Irrigation effects, *Agriculture, *Dry farming, Idaho, Wheat, Barley, Hay, Regression analysis, Income.

A paucity of yield data does not allow direct measurement of the contribution from irrigated crop agriculture, nor does it allow evaluation of the contributions from livestock which are dependent upon irrigated feed. In order to isolate the dryland and irrigated contributions for wheat, barley, and hay, county data for southern Idaho (34 counties) were assembled for irrigated acres, dryland acres, and total production. Regression analysis was performed with total output a function of dryland acres and irrigated acres. Regression results indicate that 80% of Idaho farm income is associated with irrigation, and that 75% of the farm income in the 17 western states is associated with irrigation. For the United States as a whole, 13.7% of the total cropland (irrigated land) produced 41.3% of all cash receipts from farming in 1978. If 14% of the land can produce 40% of the value of production, perhaps 35% of our land can produce all our food and fiber needs. Such an allegation has several implications in terms of the adequacy of our land and water resources. Irrigated agriculture is far more important on the basis of dollars of output than one might expect by simply observing and comparing dryland and irrigated acreage data. The role of technology has r
been exhausted, especially if current dryland are
could be made to produce like those that
already irrigated. (Moore-IVI)
W84-01947

EROSION IN RELATION TO FILTER DESIG CRITERIA IN EARTH DAMS,
California Univ., Davis.
K. Arulanandan, and E. B. Perry.
Journal of Geotechnical Engineering, Vol. 1
No. 5, p 682-698, May, 1983. 11 Fig, 3 Tab, 42 R

Descriptors: *Rockfill dams, *Earth dams, *E
sion, *Critical shear stress, Dam stability, Pipi
failure, Dam failure, Dam filters, Clay, Dam co
Design criteria.

The current design practice for filters in earth a
rock fill dams permits the use of widely grad
sand-gravel mixtures as filter materials. The use
these criteria without consideration of the erodi
lity characteristics of the core material and cra
potential of the filter has caused near failure a
total failure of several dams. A new method
presented for quantifying the erodibility of so
based on the use of critical shear stress, Tc, dev
oped due to hydraulic flow in the cracked zone
a dam. Critical shear is influenced by the clay ty
and amount, composition of pore and erodi
fluid, and structure of the soil. The use of Atte
berg Limits to classify erosion characteristics
inadequate. A direct correlation between the cri
cal shear stress required to cause erosion and t
piping failure of several dams was found. Co
fines with Tc values less than 4 dynes/sq cm a
one of the contributing factors causing piping fa
ure of dams. Even if the clay is erodible, it
possible to prevent dam failure is adequate prote
tive filters are provided. Correctly quantifying er
dibility and carrying out filtration tests using t
eroded fines and proposed filter material is recon
mended for the safe design of protective filte
The degree of clogging of the pores in the filt
material may be used to evaluate its cracking su
ceptibility. (Moore-IVI)
W84-01958

STRESS AND SEEPAGE ANALYSIS O EARTH DAMS,
Schnabel Engineering Associates, Bethesda, MD
G. C. Li, and C. S. Desai.
Journal of Geotechnical Engineering, Vol. 10
No. 7, p 946-960, July, 1983. 14 Fig, 3 Tab, 21 Re

Descriptors: *Earth dams, *Stress analysis, *Seep
age, *Dam stability, *Earthworks, Soil mechanics
Mathematical models, Embankments, Soil satura
tion, Dam construction.

A finite element procedure is developed for stres
seepage and stability analysis of dams and earth
banks. The soil behavior is modeled by using linea
elastic, nonlinear elastic and plasticity based laws
The seepage analysis is based on a residual flo
scheme involving saturated and unsaturated zone
in which the original mesh remains invarian
during the transient flow and iterations. By usin
the same mesh for stress analysis including sequen
tial embankment construction, it is possible to su
perimpose directly the effects of external and seep
age forces. If appropriate pressure-permeability re
lations are available, it is possible to incorporat
effects of partial saturation during construction.
is also possible to include in the analysis changes i
the dam geometry during the deformation process
The procedure has been found to provide satisfac
tory correlation with analytical solutions and fiel
observations for a number of problems. It can b
useful and appropriate for nonlinear stress, seepag
and stability analysis of dams and earth banks
(Moore-IVI)
W84-01959

UNSTEADY SEEPAGE ANALYSIS OF WAL LACE DAM,
Georgia Inst. of Tech., Atlanta. School of Civi
Engineering.
M. M. Aral, and M. L. Maslia.

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nal of Hydraulic Engineering, Vol. 109, No. 6, 9-826, June, 1983. 12 Fig, 1 Tab, 27 Ref.

riptors: *Embankments, *Earthworks, *Seep- Mathematical models, Unsaturated flow, Satu- flow, Dam piping, Dam filters, Drainage, pressure, Finite element analysis, Pumped ge, Georgia, Oconee River, Wallace Dam.

Wallace Dam is a pumped storage hydroelec- project on the Oconee River near Eatonton, gia. The main body of the Wallace Dam sts of a concrete gravity non-overflow sec- a gated spillway section, and east and west fill embankment sections. Transient seepage rns in the west dike station 58+00 of Wallace were studied through a saturated-unsaturated ge analysis using a finite element solution nique. Numerical results obtained from the el using Design Data III soil types compare ably with the recorded field observations. internal drainage structure is efficient in re- g pore pressures in downstream sections of arth dam. Considerable care should be given e design of the inner filter zone to avoid al piping or blockage, or both, of the filter ture due to piping. The numerical results pre- igher permeabilities in the clay fill zone with her quantity of seepage. Suitability of the element analysis is once again demonstrated alyzing transient behavior of an earth dam saturated-unsaturated flow analysis. (Moore-

-01960

Concrete

UFACTURE AND USE OF ASBESTOS ENT PIPES,
Taunton.
istry and Industry, No. 17, p 667-670, 5 Sep- er, 1983. 5 Fig, 2 Tab.

riptors: *Pipes, *Asbestos cement, Cement, stos, Drinking water, Public health, Coatings, sion.

stos cement (AC) ranks as one of the major materials in service today. Estimates suggest 15 to 20% of all water distribution mains in United Kingdom are made of AC. The high ty compaction of the cement, reinforced by sbestos fiber, gives the pipe material its high gth characteristics and its inherent resistance ggressive attack. Particular features of the facturing process ensure that the asbestos are oriented such that mechanical strength in the axial and circumferential plane is devel- each lamination is consolidated in turn, as up proceeds, by a hydraulically loaded roller ; the resulting material is homogeneous, tough asily machineable; and the mandrel confers a th finish to the pipe bore. Asbestos fiber is ively inert to all substances commonly found ound water, potable water and sewage. The density compaction of the cement in the pipe provides good resistance to aggressive attacks. al studies on the effects of possibly ingested tos have indicated no increased risk arising fiber ingestion. Epidemiological studies show bstantive evidence of risk. (Baker-IVI)
02019

POLYETHYLENE PIPING SYSTEMS FOR USE IN THE WATER INDUSTRY,
Stewarts and Lloyds Plastics, Huntingdon (England).
J. A. Denning.
Chemistry and Industry, No. 17, p 671-673, 5 September, 1983. 3 Fig, 1 Tab.

Descriptors: *Pipes, *Polyethlyene, Pipelines, Water distribution, Corrosion.

Polyethylene piping systems now being introduced to the water industry are modelled on the system used since about 1969 for the distribution of natural gas. The water system will differ in operating pressure and in the pigmentation of the polymer, but it will use the same high performance medium density polyethylene as supplied to meet gas specifications. Polyethylene piping systems do not need internal or external protection against corrosion and no environment effects should be observed on the system during its life. However, piping installed in ground contaminated with organic solvents or fuel oil can result in the water being contaminated by these pollutants diffusing through the pipe wall. (Baker-IVI)
W84-02020

8G. Materials

RECENT DEVELOPMENTS IN MATERIALS USED IN THE WATER SUPPLY INDUSTRY,
R. F. Stokes.
Chemistry and Industry, No. 17, p 659-663, 5 September, 1983. 7 Fig, 8 Ref.

Descriptors: *Pipes, *Water distribution, Water supply, Pipelines, Asbestos, Cement, Iron, Plastics.

Most pipes used in the drinking water systems are grey iron, either vertically cast or centrifugally spun cast, and consequently brittle. Iron pipes seldom fail in service due to strength limitations alone. Corrosion is more usually the cause and a reduction in wall thickness might be expected to exacerbate this problem. The typical method of protecting pipes from external corrosion has been to use a bitumen dip or coal tar. Currently recommended methods include the use of polyethylene sleeving as this has been shown to provide long term benefit at a relatively low cost. Zinc spray coating applied to the iron pipe before bitumen application has also been effective. Asbestos cement pipes have been used successfully for many years as pressure pipes. They are reasonably cheap and relatively trouble free in hard water areas. Plastic pipes came into use in 1955, but not until the 1960s with the use of uPVC, did their presence become significant. (Baker-IVI)
W84-02017

DEVELOPMENT OF PROTECTION SYSTEMS FOR BURIED DUCTILE IRON PIPES,
Stanton and Staveley Ltd., Nottingham (England).
H. H. Collins.
Chemistry and Industry, No. 17, p 663-666, 5 September, 1983. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Pipes, *Corrosion, Zinc, Plastic, Coatings, Tar, Ductile iron pipes, Pipelines, Water distribution, Sewer systems, United Kingdom.

The behavior of grey cast iron, when buried in a wide variety of soils, has been extensively explored by the National Bureau of Standards. Such pipe is by far the most common type used at present in Britain's cities and countryside for the transport of water, sewage, or gas. In general, the wettest soils with the lowest electrical resistivities are the most aggressive; the rate of corrosion penetration into iron tends to decrease with time; iron surfaces are attacked non-uniformly, leading to irregular pitting rather than uniform thinning; and corrosion results are extremely variable, even for identical materials buried in the same soil. For many years the standard protection to cast iron pipes has been a 70-100 micrometer coating of coal tar, applied by dipping the pipe into a bath of molten tar. Additional protection is needed by all iron pipes likely to be exposed in corrosive soils. The most convenient and economic system and widely used in the United Kingdom is encasing the pipe in a sleeve of polyethylene film 200 micrometers thick. A thin coating of metallic zinc with a top coating of coal tar or bitumen paint can be used to protect spun iron pipes. (Baker-IVI)
W84-02018

FACTORS INFLUENCING THE CHOICE OF MATERIALS FOR EPOXY RESIN RENOVATION OF WATER MAINS,
WRC Engineering, Swindon (England).
I. C. Warren.
Chemistry and Industry, No. 17, p 673-678, 5 September, 1983. 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Pipes, *Water distribution, *Epoxy resins, Resins, Water mains, Microorganisms, United Kingdom.

The overall condition of the water distribution network is of concern in the water industry of the United Kingdom. Accelerated durability testing of epoxy resin linings has shown that a life of at least 20 years can be realized. No mechanism for deterioration has been observed and service lives in excess of this figure are expected. Epoxy resin linings which have been in service for up to four years are showing no signs of deterioration. Increases in microbiological activity following renovation of water mains with epoxy resin materials have frequently been noted. This activity is generally restricted to nonpathogenic microorganisms capable of growing at 22 degrees C on yeast extract agar. Epoxy resins containing benzyl alcohol can support the growth of microorganisms within the limits of the test procedure. The use of resins free of benzyl alcohol has not completely eradicated the incidence of microbial activity but it has reduced the duration of the problem. (Baker-IVI)
W84-02021

EVALUATION AND DEVELOPMENT OF TECHNICAL THERMOPLASTIC SYSTEMS FOR DESALINATION AND OTHER WATER TREATMENT APPLICATIONS,
General Electric Plastics B.V., Bergen op Zoom (Netherlands).
For primary bibliographic entry see Field 3A.
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